Railway Mechanical Engineer

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Eternal vigilance seems to be the price that all railroads must pay in order to keep the number of hot boxes at a minimum. A number of car departments have devised systems for checking all items of work pertaining to car journal and bearing maintenance but, nevertheless, an epidemic of hot boxes persists in breaking out every so often. It is generally accepted that all hot box troubles do not originate with journal, bearing or packing defects. But how many car departments see that their inspectors make as careful a check of other parts of the car which, if defective, will eventually cause a hot box, as they make when inspecting the condition of the journal boxes?

Check your side bearing clearance

To illustrate; one railroad found after investigation that the majority of cars set out in transit because of hot boxes had no side bearing clearance. In other words, most of the cars set out were riding hard on the side bearings thus delivering additional shock loads to the truck sides and producing excessive variations in journal bearing loads.

It required only a letter of instruction to the various car repair points, together with a discussion of the subject at the weekly staff meeting of the car department foremen, to clear up the side bearing situation in a comparatively short time. A marked reduction in the number of hot boxes was observed during the month following.

Slightly over a year ago, the members of the old Chief Interchange Car Inspectors' and Car Foremen's Association of America, assembled in regular annual convention at Chicago, voted to change the name of the association to Railway Car Department Officers' Association, hoping thereby to secure more general recognition of the increased scope of the association's work and activities. Apparently this recognition is already in a fair way to be achieved, since T. W. Demarest, general superintendent of motive power of the Pennsylvania, Western region, who is chairman of the Arbitration Committee of the American Railway Association, mentioned the change favorably at the convention this year, outlining the possibilities of the newly christened organization and in effect placing on its shoulders the mantle of the old Master Car Builders' Association. Mr. Demarest said, in effect, that technical problems confronting railway car department officers are now handled effectively by the Mechanical division of the American Railway Association, but there is pressing need for a national association of car supervisors and inspectors who can get together once a year and not only recommend changes in interchange rules but make helpful suggestions for the betterment of general car department conditions and operation. May the Railway Car Department Officers' Association, which held its first convention under the new name this year, rapidly prove itself worthy of the honor conferred on it.

The mantle of the M. C. B. Association

The discussion that has been going on as to whether substituting cast steel yokes for wrought iron constitutes wrong repairs on the Reader's Page in recent issues is, perhaps, a fairly good example of the controversies that are constantly coming before the Arbitration Committee. There are always some who seem to feel it their business to try and get around the spirit of the law by bickering over the letter. The Arbitration Committee has always done one of the most important committee jobs of the Mechanical Division and has done it well. It formulated a preamble to the interchange code that many of those whose work has to do with freight car interchange could well commit to memory. This preamble which is headed "preface" in the rule book states that "these rules are formulated as a guide to the *fair and proper* (the italics are ours) adjustment of all questions arising between the car owner and the handling company." However, quoting one of our correspondents who recently wrote us a letter on this subject, "the trouble with a great many of us is that we would like to pick out the rule that is most favorable to the case we want to dispose of, ignoring the rule that may be less favorable."

The A. R. A. Interchange rules

There will always be differences of opinion which can only be settled by rulings of the Arbitration Committee. But is the constant repetition of cases on technical points differing from each other by split hairs, which have been passed on repeatedly by the Committee, really worth while?

Railroad Data, a weekly information service issued by the Committee on Public Relations of the Eastern Railroads, recently carried an interesting review of the increased efficiency and economy of American railroads since 1920. Ever since the return of the railways to private operation in 1920, after the 26-month period of federal control, the roads have bent every energy toward increasing their efficiency and economy of operation. The following data tells its own story. In 1920, 24.5 per cent of the freight locomotives on the lines of the Class I railways were in bad order; in 1926, this figure had been reduced to 16.4 per cent. In 1920, 7.0 per cent of the freight cars on the lines of the Class I railways were in bad order; in

Railroad improve operating efficiency

1926, this figure had been reduced to 6.5 per cent. In 1920, each freight car on the Class I railways traveled, on the average, 25.1 miles each day; in 1926, this figure had been increased to 30.4 miles per day, an increase of 21 per cent. In 1920, each freight car on the Class I railways performed each day, on the average, a service equal to carrying 498 tons of freight for the distance of one mile; in 1926, this figure had been increased to 532 ton-miles, an increase of 7 per cent. In 1920, the average freight train on the Class I railways consisted of 37 cars; in 1926, this figure had been increased to 45 cars, an increase of 22 per cent. In 1920, the average freight train on the Class I railways carried 708 tons of freight; in 1926, this figure had been increased to 772 tons, an increase of 9 per cent. In 1920, the average freight train speed (counting all stops) on the Class I railways was 10.3 miles per hour; in 1926, this figure had been increased to 11.9 miles per hour, an increase of 16 per cent. In 1920, each freight train on the Class I railways performed each hour, on the average, a service equal to carrying 7,303 tons of freight for the distance of one mile; in 1926, this figure had been increased to 9,207 ton-miles, an increase of 26 per cent. In 1920, on the Class I railways, 197 lb. of coal were required in the freight service to move 1,000 gross ton-miles of freight; in 1926, this figure had been reduced to 155 lb., a reduction of 21 per cent. In 1920, on the Class I railways, 18.8 lb. of coal were required in the passenger service per car mile; in 1926, this figure had been reduced to 15.8 lb., a reduction of 16 per cent. The mechanical department in many ways is partly responsible for the splendid showing evidenced in the above figures. The decided reduction in bad order cars and locomotives can be almost entirely attributed to this department, as its primary function is the maintenance of equipment. Larger and more efficient locomotives and cars have been designed and built during the past six years. The mechanical department officers have had much to do with the final design of this modern equipment. The mechanical department has fully co-operated with the other departments in order to make possible during the past six years these very decided improvements in operating efficiency.

Cutting oils for production tools

Many machine tools used in railroad shops, particularly full automatic and semi-automatic screw machines, require cutting oils to obtain the maximum production and accuracy. A railroad that uses many of these machines may well make a careful study to determine the proper grade of cutting oil to use in order to secure maximum quantity and quality of work from them. On one railroad that has a large number of automatic machines on its system it was noticed that the idle machine hours were unusually high owing to the frequent regrinding of tools. It was also noticed that the rejection of finished parts was too high. A thorough study of cutting oils was undertaken in which it was found that the cutting oil being used was not properly carrying away the heat from the tools when the machines were run at the maximum speeds and feeds for which they were designed. This meant that to continue to use this cutting oil would necessitate reducing the feed and speed in order to reduce idle machine hours and the rejections of finished parts. This would curtail production, which was out of the question. As a result of the investigation a cutting oil was ultimately found, which reduced the idle machine hours, improved the quality of production, which meant a minimum number of rejected parts, and reduced the frequency with which the cutting tools required replacement.

Again, unlike the case stated above, a railroad may be using a good grade of cutting oil but still be not getting maximum production. In a case like this the question of idle machine hours and rejection of parts is not involved. Instead, it is a question of utilizing the maximum speed, feed and depth of cut which the cutting oil will properly refrigerate. To obtain the maximum production of modern machine tools requires an efficient cutting oil, and then its capacity as a coolant must be fully utilized.

Aids to engine operation

The question of how many or how few mechanical devices it is advisable to install as aids to enginemen in operating locomotives is receiving general consideration at the present time. At the Traveling Engineers' Convention just recently held at Chicago, for example, considerable time was devoted to a discussion of the practical value of back pressure gages and, while by far a great majority of the railroad men in attendance seemed to favor cut-off control in accordance with back pressure, either automatic or through manual operation of the reverse lever, a number of the members said that locomotives were operated satisfactorily for years without back pressure gages, superheater pyrometers, speed control devices, automatic bell ringers, whistle blowers, etc. They said that these devices are more or less expensive to install, require constant attention from a maintenance standpoint, make the back boiler head look like an instrument board and are often disregarded by certain enginemen in spite of the best efforts of the traveling engineers to insure their use.

This testimony at the Traveling Engineers' Convention constitutes quite an indictment of modern practice in equipping locomotives with labor-saving devices and apparatus designed to give enginemen a better knowledge of actual working conditions. Will this indictment bear analysis? The *Railway Mechanical Engineer* thinks not. As desirable as simplicity is, this is not the age of simplicity—and who would want to go back to the old days when an engineman, home from his daily run, had no radio to tinker with or automobile to take him and his family for a joy ride? Railroading also has become more complicated in all its phases, a condition made necessary by the insistent modern demand for less manual labor and greater fuel and operating economy. In former times, when reverse levers could be thrown with one hand, and the only gages required were one to indicate the steam pressure and another, braking conditions, the engineman depended upon his judgment and sense of hearing in determining if he was getting the best results from the locomotive. This operation was "satisfactory" in that he got the train over the road on schedule time. One thing is sure, however. The horsepower developed per unit of fuel consumed was but a fraction of that obtainable with modern locomotives. Fuel economy was not in those days a vital factor, with coal costing the railroads one dollar or less a ton on the tender.

It was testified on the floor of the convention that enginemen can no longer depend on their sense of hearing as a reliable and final guide in engine operation. Locomotives are now so large and part of the exhaust steam so frequently used in feedwater heaters that the sound of the exhaust affords little indication of how the engine is operating. Tests have shown that both fuel and water consumption go up just as soon as locomotives are oper-

ated regardless of back pressure and even the oldest and most experienced enginemen make mistakes in judgment unless some means is provided of showing them just what back pressure results from varying the position of the reverse lever.

Back pressure gages and other mechanical aids to engine operation cost something to install and maintain, and unless properly maintained, they are valueless. It may safely be said, however, that both the first cost and maintenance cost in most cases are insignificant compared with the resultant savings in fuel and improved operation. The argument that these devices will not be used by enginemen of the old school, even when installed, also is unsound, or at least is not sufficiently valid to be a determining factor. When asked regarding this question, the mechanical engineer on one of the largest railroad systems said that in some few cases it may prove practically impossible to induce enginemen to use the devices provided for them, but eight men out of ten will recognize the merit of the devices, see how they help in securing improved operation, and welcome the opportunity to effect this improvement.

Apprenticeship

Few discussions of the railroad shop apprenticeship question have made a more distinct or profound impression than the one at the September meeting of the New York Railroad Club. T. C. Gray, supervisor of apprentices of the Missouri-Kansas-Texas, read a paper telling of the practices of his road, emphasizing some of the rather radical departures from those followed by other roads. Extracts from Mr. Gray's address will be found elsewhere in this issue and will be of special interest to those who have followed the articles in the August and September numbers, outlining the practices which are being followed in reorganizing the apprentice systems on the Baltimore & Ohio and the Missouri Pacific.

There has been much question as to the value of psychological tests used in connection with the selection and assignment of employees. Railroad officers as a whole have not been inclined to take these matters very seriously; indeed, industry at large has not been very keen about rushing into this new development, but has been waiting to see the results obtained by those who are pioneering in the application of psychology to industry. The experiments which have thus far been made on the Missouri-Kansas-Texas, with the aid of representatives of the Kansas State Teachers College, indicate that intelligence tests, properly applied, may prove exceedingly helpful in checking up on the selection of applicants for apprenticeship in the various trades.

The Missouri-Kansas-Texas, and a number of other roads as well, feel that it is a duty and responsibility of the department foremen to see that the apprentices are properly instructed in shop practices, rather than to leave this responsibility to apprentice shop instructors. The question is naturally a debatable one since a number of roads have employed shop apprentice instructors with most effective results for many years. It is quite likely that a lively discussion on this phase of the question would have been precipitated at the railroad club meeting had the time not been so limited.

Mr. Gray also jolted the group when he indicated that after a most careful and critical study of exactly what skill and information are required by the successful mechanic in each of the various shop crafts, it had been decided to minimize the amount of attention given to mechanical drawing in the schoolroom and to enlarge upon the importance of shop sketching.

Throughout Mr. Gray's paper, and expressed again and again by those who took part in the discussion, was the thought that after all, the successful apprentice system must not only turn out skilled mechanics, but that much emphasis must be placed upon those things which help to broaden the viewpoint and develop and strengthen the characters of the apprentices.

Eliminate the guesswork

In the development of the modern locomotive the problem of increasing capacity without exceeding weight and space limitations has in many cases resolved itself into one of the selection of materials of such character as to provide greater strength without an increase in weight. Probably no single development has contributed as extensively in the solution of this problem as the introduction of alloy steels for locomotive parts. Fortunately for the railroads the automotive industry has completed the pioneer work in this field so that at the present time there is a wealth of information, backed by years of experience and expensive research work, available for those who must handle this material. Closely allied with the use of steel is the subject of heat treatment, without a practical knowledge of which and without the proper equipment for carrying out the processes, a great part of the advantages possible with the use of alloy steels can not be realized.

Some of the discussion during the recent convention of the International Railroad Master Blacksmiths' Association at Buffalo, N. Y. would cause an observer to form the opinion that many of these men are not quite sure of their ground when making or repairing locomotive parts in which alloy or high-carbon steel is used. To men whose past experience has familiarized them with the forging of common iron or low-carbon steel the introduction of high-carbon or alloy steels, with the consequent necessity for accurate heat treatment, has brought them squarely face to face with the problem of immediately acquiring a broad education on an entirely new phase of blacksmith shop work.

A knowledge of heat treatment leads to the conclusion that successful work in this art can not be accomplished with shop equipment that leaves a great part of the job to individual guesswork. Modern furnace equipment and accurate devices for temperature control are an absolute necessity. Mechanical officers must realize that dollars saved through the use of high grade steel may be entirely lost as a result of improper and non-uniform heat treatment.

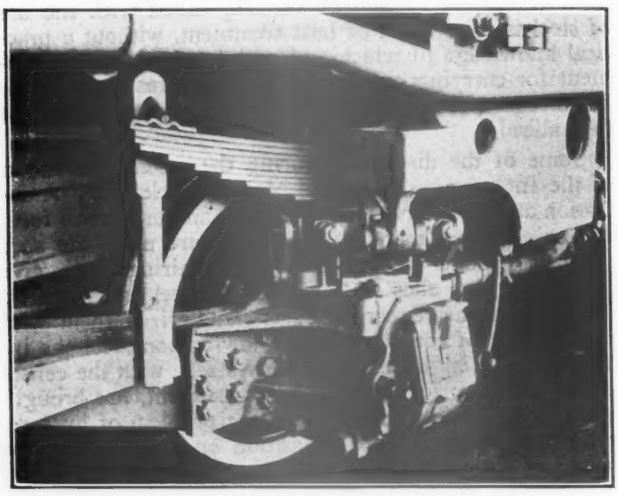
Inasmuch as the railroad blacksmith is the one directly concerned with this problem it would seem that one of his greatest present needs is practical and comprehensive information concerning the characteristics and heat treatment of steel used in locomotive and car construction. The International Railroad Master Blacksmiths' Association will be neglecting an opportunity if it does not take steps to provide this information either from the experiences of railroad men who have made a study of the problem or from outside sources. Fortunately the storehouse of information is well filled as a result of the work that has so far been accomplished by the research departments of the steel companies and through the activities of the American Society for Steel Treating in disseminating this information in practical form.

D. & R. G. W. buys ten 2-8-8-2 type locomotives

Maximum tractive force of 131,800 lb. at 70 per cent cut-off—Weight on drivers 559,500 lb.

TEN four-cylinder simple articulated 2-8-8-2 type locomotives were recently delivered to the Denver & Rio Grande Western by the American Locomotive Company which represent the most recent effort to produce in a single traction unit the maximum power obtainable within the restrictions of rails, curves, grades and clearances. Permissible rail loads were relatively high and clearances relatively large so that it was possible for the designers to take complete advantage of these two important factors. As a result, a locomotive of abnormally large size was made possible for handling the desired tonnage over the ruling grade at the desired speed.

These locomotives develop a maximum tractive force of 131,800 lb. produced at 70 per cent cut-off, which is



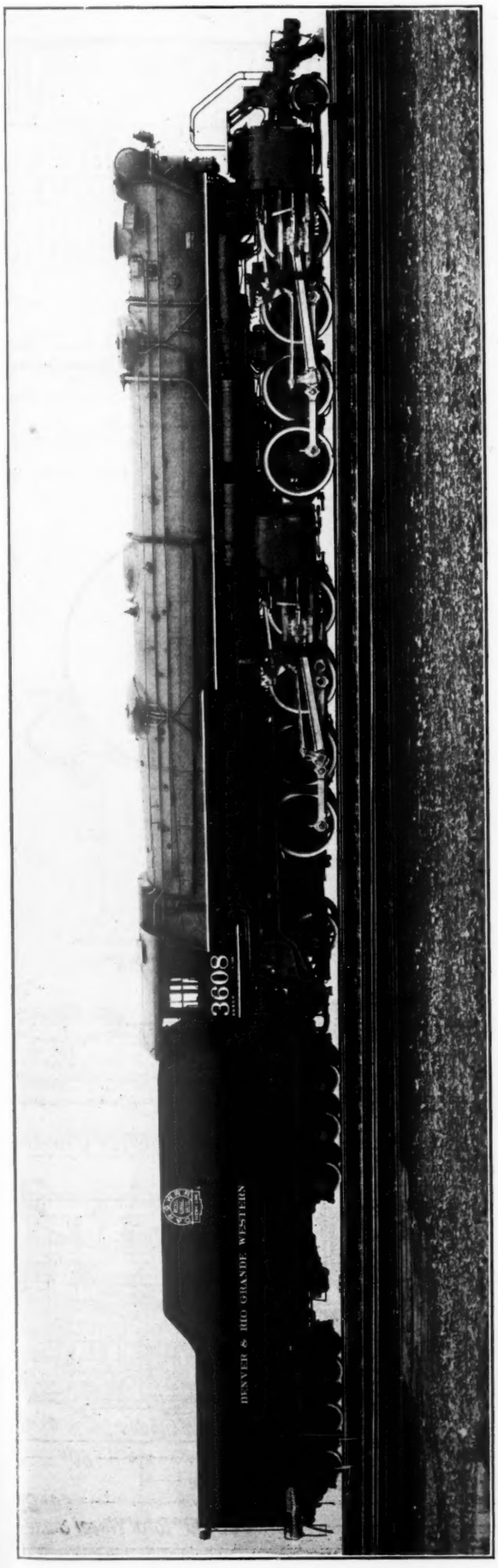
The trailer truck

believed to be the largest power output of any coal-burning locomotive ever built. The cylinders are 26 in. in diameter by 32 in. stroke, and the boilers operate at a working pressure of 240 lb. per sq. in. The driving wheels are 63 in. in diameter. The eight pairs of coupled drivers carry a load of 559,500 lb. which gives a factor of adhesion of 4.2. These locomotives were designed to negotiate 22-deg. curves. The dimensions, weights and proportions of these locomotives are shown in the table.

This type of locomotive was selected because it was considered impossible to build a non-articulated locomotive that would handle the trains that the D. & R. G. W. desired to operate. These locomotives are scheduled to handle 3,000 tons east from Grand Junction, Col., and as this constitutes a light load as far as Glenwood Springs, 89.47 miles, it is intended to run the engines at a speed of about 25 m.p.h. to that point. The grade changes at Glenwood Springs and the speed will be reduced to about 15 m.p.h. as far as Minturn, which is 58.13 miles from Glenwood Springs. From Minturn to the Continental Divide at Tennessee Pass, 20.51 miles, the locomotives will be operated in a three-engine train, being assisted by two smaller mallet type locomotives. The ruling grade eastward between these two points is 3 per cent, with a maximum curvature of 16 deg. The locomotives will be run through alone with the train to Salida or Pueblo, 66.34 miles and 162.18 miles from Tennessee Pass, resp ctively. Westbound, out of Salida, the loco-

Table of dimensions, weights and proportions of the 2-8-8-2 Type D. & R. G. W. locomotives

Railroad	D. & R. G. W.
Type of locomotive	2-8-8-2
Service	Freight
Cylinders, diameter and stroke	4—26 in. by 32 in.
Valve gear, type	Walschaert
Valves, piston type, size	14 in.
Maximum travel	7¼ in.
Outside lap	1⅞ in.
Exhaust clearance	None
Lead in full gear	3/32 in.
Cut-off in full gear, per cent	70
Weights in working order:	
On drivers	559,500 lb.
On front truck	40,500 lb.
On trailing truck	49,000 lb.
Total engine	649,000 lb.
Tender	343,500 lb.
Wheel bases:	
Driving	33 ft. 6 in.
Rigid	16 ft. 9 in.
Total engine	62 ft. 10 in.
Total engine and tender	108 ft.
Wheels, diameter outside tires:	
Driving	63 in.
Front truck	33 in.
Trailing truck	42 in.
Journals, diameter and length:	
Driving, main	12 in. by 14¾ in.
Driving, others	11 in. by 14¾ in.
Front truck	6½ in. by 12 in.
Trailing truck	9 in. by 16 in.
Boiler:	
Type	Straight top
Steam pressure	240 lb. per sq. in.
Fuel, kind	Soft coal
Diameter, first ring, inside	100 11/16 in.
Firebox, length and width	218 in. by 108 in.
Combustion chamber length	72½ in.
Tubes, number and diameter	284—2¼ in.
Flues, number and diameter	74—5½ in.
Length over tube sheets	24 ft.
Grate area	136.5 sq. ft.
Heating surfaces:	
Firebox and combustion chamber	560 sq. ft.
Arch tubes	45 sq. ft.
Syphons	110 sq. ft.
Tubes and flues	6,550 sq. ft.
Total evaporative	7,265 sq. ft.
Superheating	2,295 sq. ft.
Comb. evap. and superheating	9,560 sq. ft.
Tender:	
Water capacity	18,000 gal.
Fuel capacity	30 tons
Wheels, diameter outside tires	33 in.
Journals, diameter and length	6½ in. by 12 in.
General data, estimated:	
Rated tractive force at 70 per cent cut-off	131,800 lb.
Weight proportions:	
Weight on drivers ÷ total weight engine, per cent	86.25
Weight on drivers ÷ tractive force	4.27
Total weight engine ÷ comb. heat. surface	67.8
Boiler proportions:	
Tractive force ÷ comb. heat. surface	13.78
Tractive force × dia. drivers ÷ comb. heat. surface	868
Firebox heat. surface ÷ grate area	4.1
Firebox heat. surface, per cent of evap. heat. surface	7.7
Superheat. surface, per cent of evap. heat. surface	31.6



One of the 2-8-8-2 type locomotives recently delivered to the Denver & Rio Grande Western by the American Locomotive Company

motives will be used on single-engine trains of 3,000 tons at a speed of about 16 to 17 m.p.h.

Boiler has unusually large firebox

To supply the steam to the four 26-in. by 32-in. cylinders, a straight top boiler having an inside diameter at the front of 100-15/16 in. and an outside diameter of 110 in. at the throat is provided. The barrel contains 284, 2¼-in. tubes and 74, 5½-in. superheater flues, 24 ft. long. The firebox is believed to be the largest, both in grate area and heating surface, of any locomotive firebox ever built. It has a length of 218 in. and a width of 108 in., together with a combustion chamber 72½ in. long, which gives a total evaporative heating surface of 560 sq. ft. The length of the grate is 182 in. giving a grate area of 136.5 sq. ft., with a Gaines arch located at the front end of the firebox. Two Nicholson syphons are applied in each firebox, together with American arch brick, and a Type A superheater of 74 units is employed. Bituminous run of mine coal is fed to the grates by a Standard Type B stoker. The total evaporating surface of 7,265 sq. ft. is made up of 4,000 sq. ft. in the tubes, 2,550 sq. ft. in the flues, 560 sq. ft. in the firebox, 45 sq. ft. in the arch tubes, and 110 sq. ft. in the syphons. The superheating surface is 2,295 sq. ft.

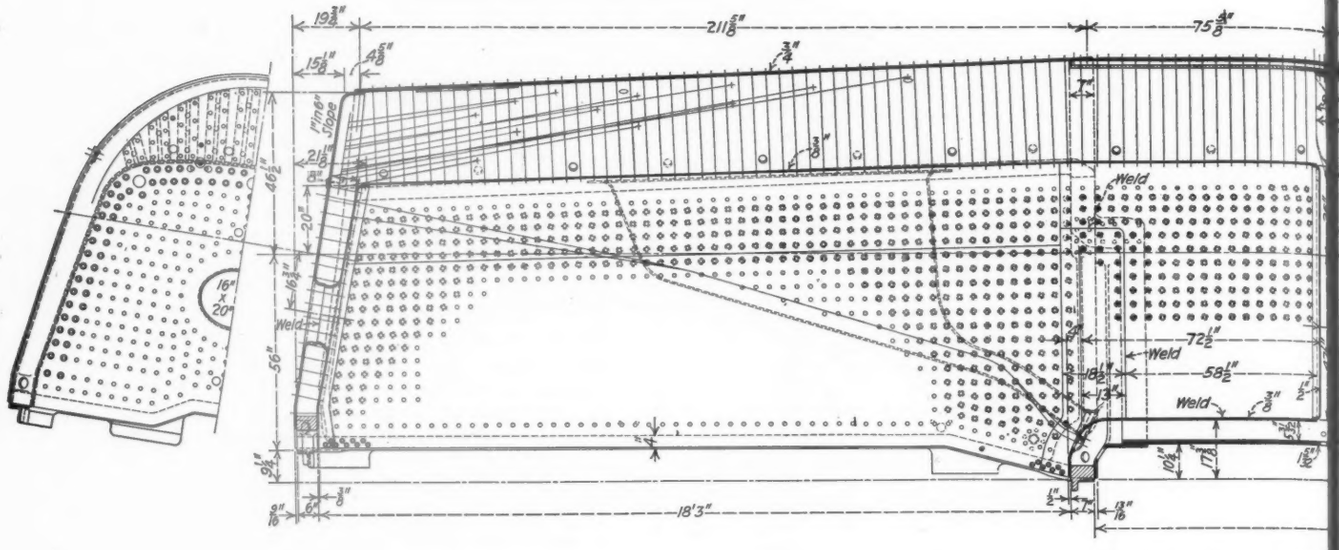
A dry pipe of steel tubing 12-in. in diameter, conveys the steam from the dome to the superheater header containing the built-in American throttle which governs its supply to the cylinders. The steam pipes carrying 240 lb. pressure through swivel joints presented a new problem in ball joint packing design, but by the use of a special Johns-Manville packing and adjustable packing glands, perfectly steam-tight joints were obtained. The entire steam pipe arrangement always presents considerable of a problem on an articulated locomotive, but it is believed this locomotive illustrates the simplest arrangement using the least amount of pipe that has yet been produced.

The header has the two regular equal size steam outlets connecting with curved steam pipes following the inside contour of the smokebox. The right-hand pipe projects through the smokebox wall below the running board and is turned to the rear by means of an elbow containing an expansion joint to lead the steam to the rear cylinders. It joins a cross-over pipe at a point just in front of the rear cylinder saddle which conveys the steam to each of the rear cylinders. The left-hand steam pipe in the smokebox terminates at its lower end in a ball joint packing gland, from which an S-shape connection provided with a slip joint, leads the steam to the cross-over pipe feeding the two front cylinders.

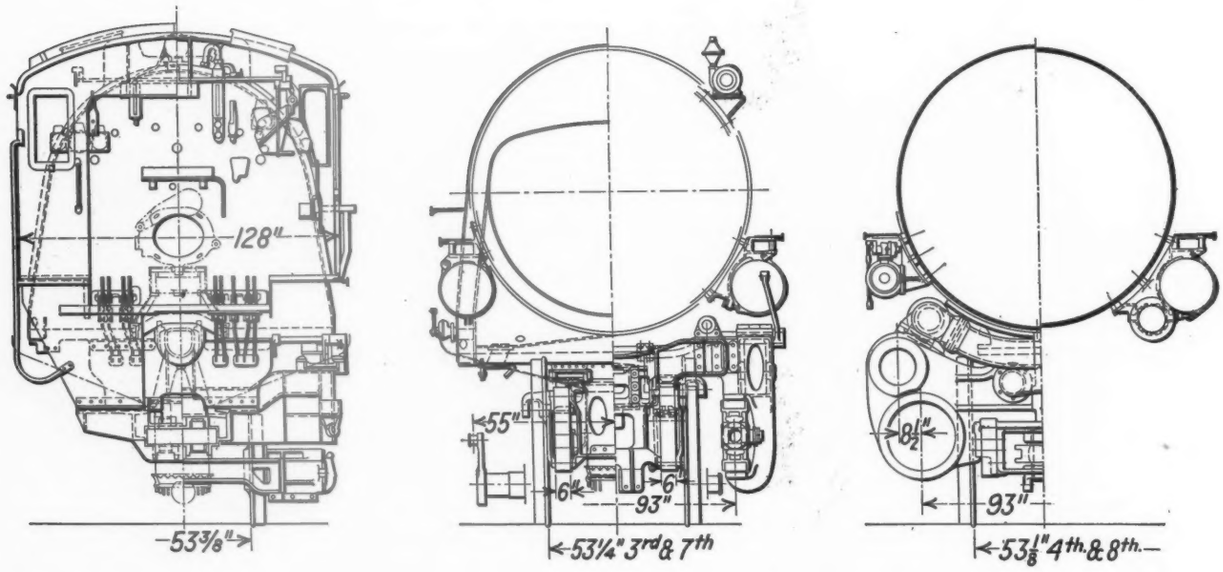
The exhaust from the front cylinders returns to the bottom of the smokebox through a similar S-shape connection, while the exhaust from the rear cylinders is brought forward through a pipe on the left side, located similar to the steam pipe on the right side. Only two outside lines of pipe are required to convey the steam to and from the rear cylinders.

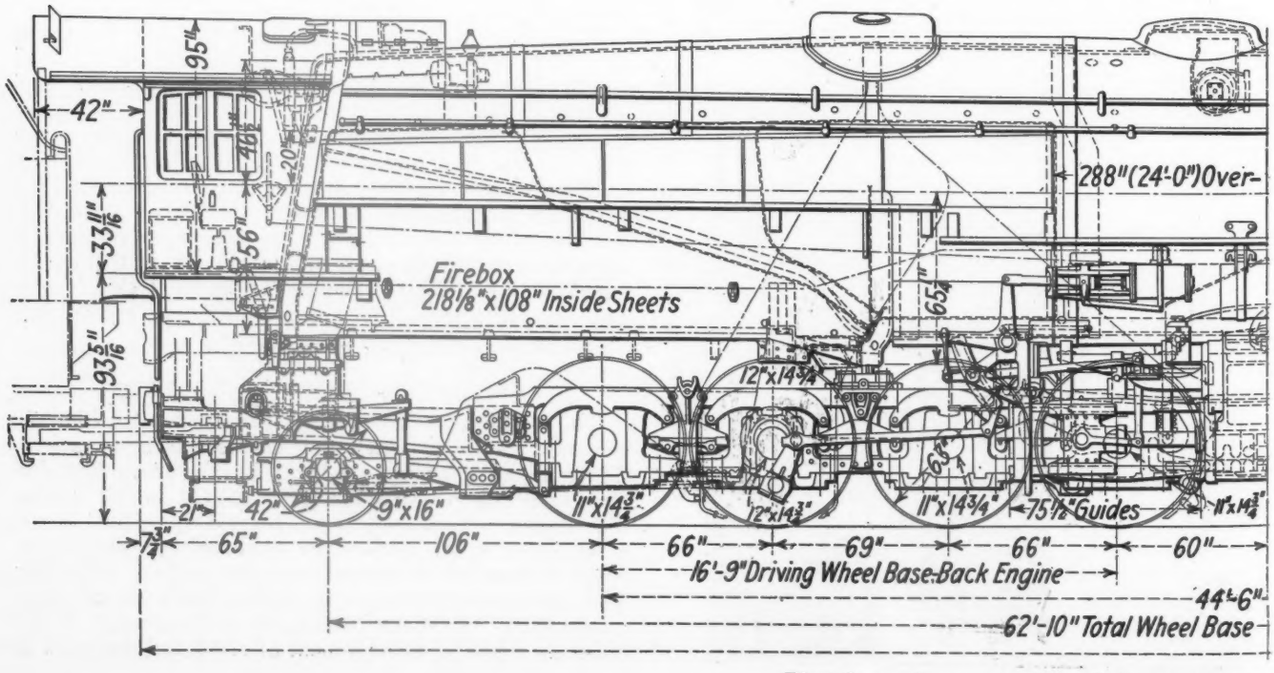
Construction features of the boiler

The crown and side sheets of this boiler are in three sections, while the combustion chamber is in one piece. The combustion chamber is welded to the crown and side sheets over the inside throat sheet and also at the bottom. The crown and side sheets are electrically welded at the sides and in order to allow for expansion at this point a bulge is provided where the sheets are welded. Welding was also used for the seams at the inside throat sheet connections. Provision was made in the design of the boiler by a special arrangement of stays and staybolts in

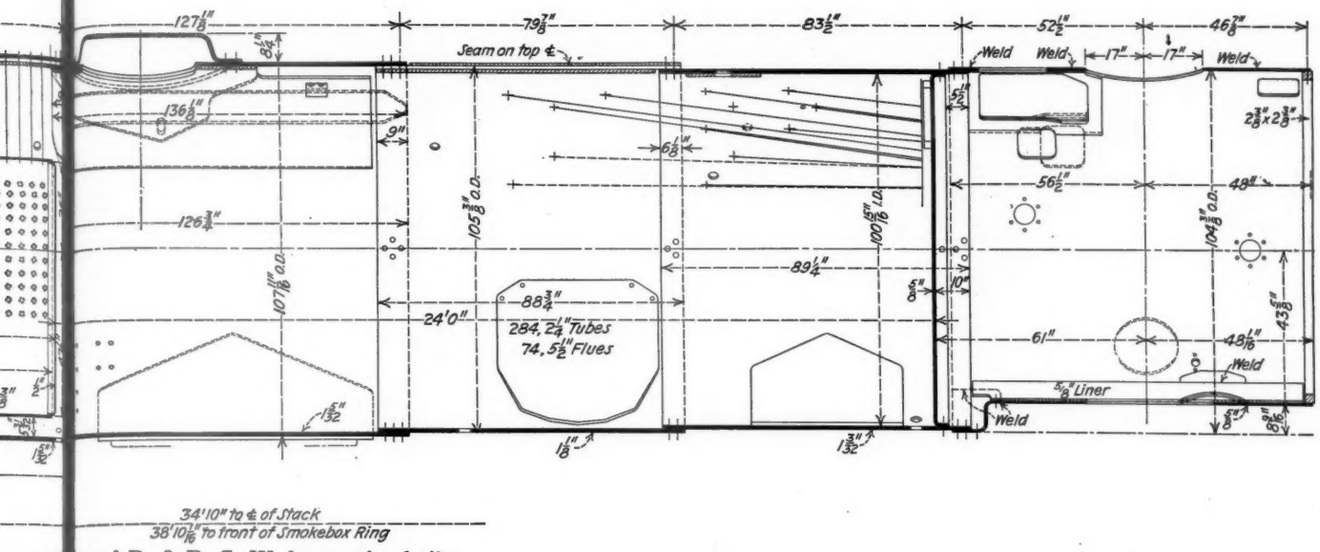


Back head and longitu ons of

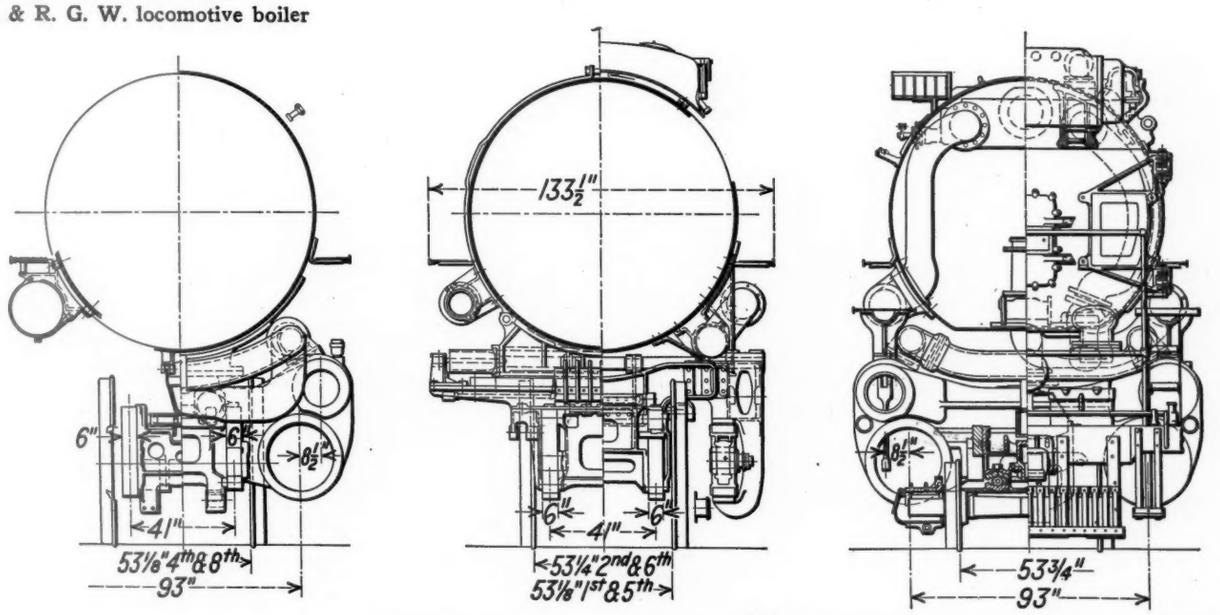


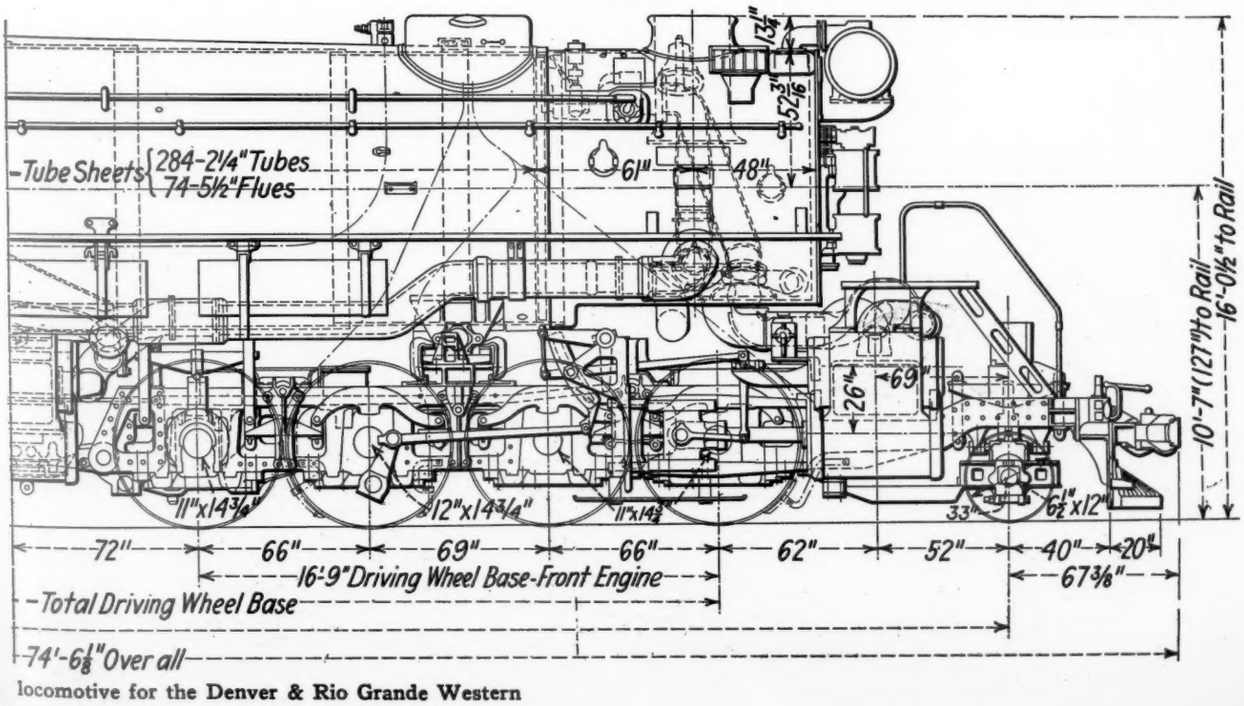


Elevation and cross sections of the 2-8-8-2 type



longitu ons of D. & R. G. W. locomotive boiler



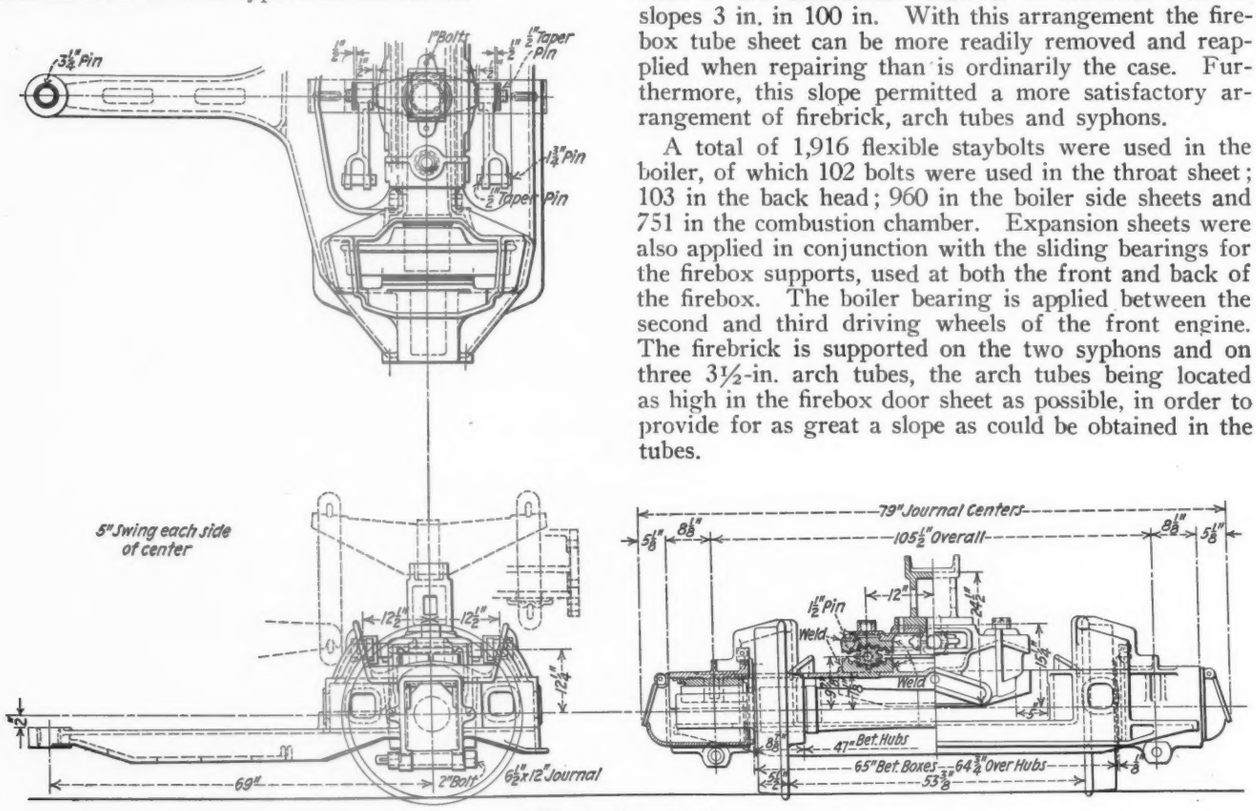


locomotive for the Denver & Rio Grande Western

the combustion chamber for the application of a combustion chamber thermic syphon in the future.

the full length of the combustion chamber, but from the back of the combustion chamber to the door sheet it slopes 3 in. in 100 in. With this arrangement the firebox tube sheet can be more readily removed and reapplied when repairing than is ordinarily the case. Furthermore, this slope permitted a more satisfactory arrangement of firebrick, arch tubes and syphons.

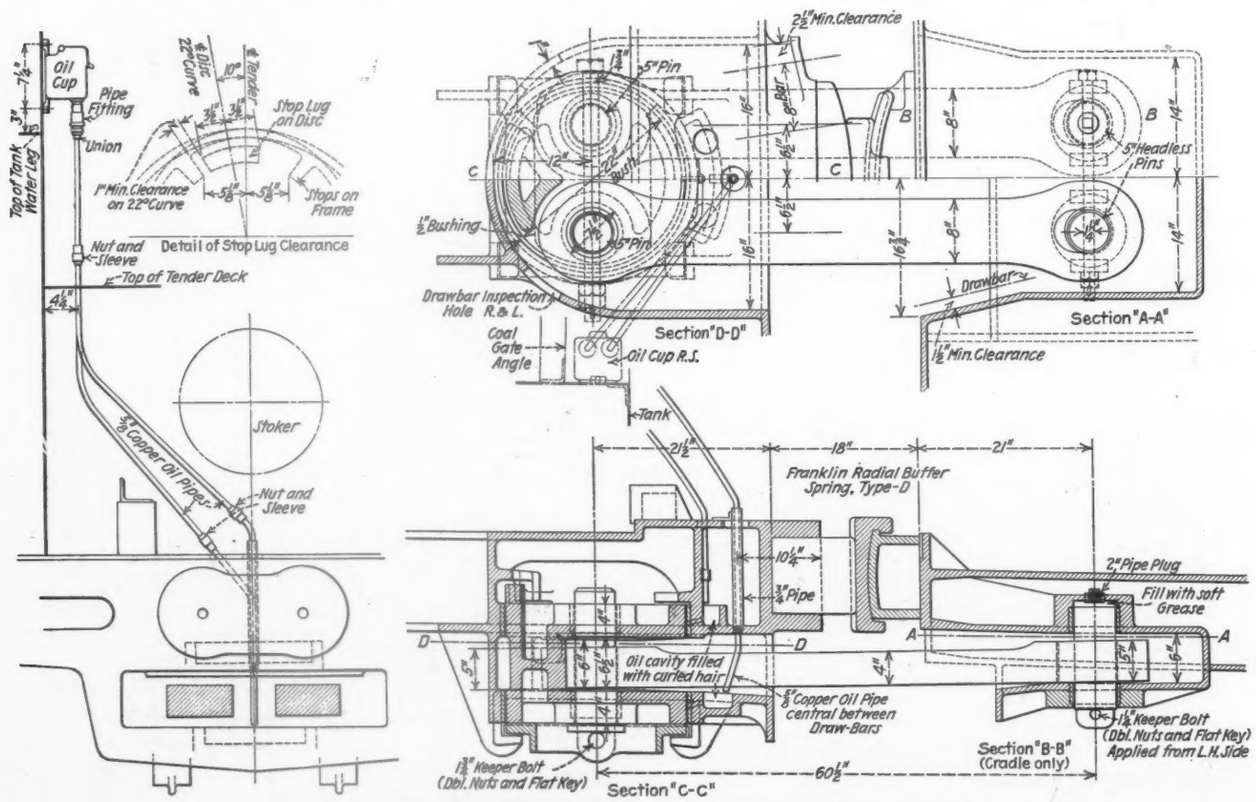
A total of 1,916 flexible staybolts were used in the boiler, of which 102 bolts were used in the throat sheet; 103 in the back head; 960 in the boiler side sheets and 751 in the combustion chamber. Expansion sheets were also applied in conjunction with the sliding bearings for the firebox supports, used at both the front and back of the firebox. The boiler bearing is applied between the second and third driving wheels of the front engine. The firebrick is supported on the two syphons and on three 3½-in. arch tubes, the arch tubes being located as high in the firebox door sheet as possible, in order to provide for as great a slope as could be obtained in the tubes.



The engine truck

It will also be seen in the boiler drawings that the crown sheet is parallel to the center line of the boiler for

The smokebox front is made in three pieces. The feedwater heater is located in the smokebox front at the



Drawbar arrangement used between the engine and tender

top, so as not to interfere with the air compressors, steam for the heater being taken from the exhaust stand inside of the smokebox. The top section of the smokebox front back of the feedwater heater, is permanent, as is also the small section at the bottom which allows the front end when open, to swing clear of the steam pipe elbow of the front cylinder. The feedwater heater is a Superheater Company's unit with a CF2 pump. Reinforcing liners are applied to the inside of the boiler shell for the feedwater heater pump foundation and boiler bearing and outside for the cylinder saddle. The main steam pump is so arranged that the removal of the shut-off valve will not be necessary in order to make interior examinations.

The running gear

The total weight of one of these locomotives is 649,000 lb., of which 40,500 lb. is carried on the engine truck, 559,500 lb. on the drivers, and 49,000 lb. on the trailer. The weight of the boiler carried on the front engine is transmitted through a single bearing. The driving wheel base of each engine unit is 16 ft. 9 in., while the total wheel base of the engine is 62 ft. 10 in.

The engine truck, shown in one of the drawings, is the Alco design, outside bearing truck, using A.R.A. journal bearings, wedges and box lids, attached to a one-piece cast steel frame. Constant resistance centering effort is provided through geared rollers operating on inclined planes, and a central semi-elliptic spring replaces the usual spindle. Alco renewable hub liners are applied to the inside faces of the truck boxes.

The trailer truck is also of Alco design and embraces an improved method of connecting the geared roller centering device to the frame structure so as to perfectly compensate for the radial swing of the truck, while the rollers travel in straight lines.

Each of these locomotives is equipped with an Elesco feedwater heater and one Hancock non-lifting injector, also Ashcroft cut-off control gages and the Alemite system of lubrication.

The tender

The tender, which has a capacity of 18,000 gal. of water and 30 tons of coal, is carried on two Commonwealth six-wheel trucks provided with clasp brakes. The wheels are 33 in. in diameter and have 6½-in. by 12-in. journals. The tender frame is also of a Commonwealth steel casting. The weight of the tender loaded is 343,500 lb.

Twin drawbars of Alco design are used between the engine to the tender. Each of the two drawbars is secured by a 5-in. pin to a casting which rotates in a cavity cast in the tender frame. Stop lugs are cast on the drawbar pivot casting which limits its rotation by engaging stops on the frame. Lubrication is provided as shown in the drawing.

High pressure steam locomotives

Assume that a boiler has been designed which will generate steam satisfactorily at 800 lb. or over—What next?

By James M. Taggart
Consulting engineer, New York

Part II—Drives and auxiliaries

ANY discussion of the types of drives and auxiliaries best suited economically to utilize steam pressure of 800 lb. and over should naturally include some consideration of the extension of power generation into the lower or condenser pressures. The writer assumed originally that the use of pressures above present practice should include condensation of the exhaust. Otherwise it would be difficult cheaply to obtain a clean feed water which is normally essential and always advisable for high pressures and high ratings.

Feed water requirements

The subject of clean feed water is with present equipment one of vital interest to all railroads. Boiler maintenance is large, due mainly to impurities in the feed water. In a number of cases chemically treated water is furnished. At high pressures the only sure method of avoiding trouble appears to be by the use of distilled water, but with distilled water there is apt to be a rapid corrosion unless air is kept entirely out of the system or the water is kept slightly alkaline. For locomotives it is simpler to treat the distilled water with some chemical that will not be affected by the high temperatures.

Normally it would not be economically feasible to distill all the water required for locomotives operating non-condensing. With condensing operation the distillation of the make-up required should involve relatively slight added cost. In many cases waste heat could be utilized so that no extra fuel would be required.

There are several types of condensers that might be used. Some types have been tried out on locomotives in Europe and on automobiles. A simple air condenser is standard practice with steam driven automobiles. Surface and jet condensers with evaporative recooling effects have been tested on locomotives and at present several turbine locomotives are operating with surface condensers. Finally there is the evaporative type of condenser. An evaporative condenser is taken here to be one in which the condensing surfaces are exposed to an air flow combined with water spray or drippage. The condenser used on the Ljungstrom locomotive operates on this principle part of the time.*

With the pressures proposed the power effect is mainly above the line of atmospheric pressure. Thus the main function for a locomotive condenser is taken

*See the *Railway Mechanical Engineer*, October and November, 1922, pages 557 and 623.

here as the condensing of the exhaust steam. It is probable that the condenser should be considered a success if it accomplishes this for maximum loads at approximately atmospheric pressure. If it does this it should give a moderate vacuum at the average loads and a high vacuum with light loads.

Evidently the simplest arrangement would be an air condenser. For the power required and the space limitations, it is improbable that any design of air condenser could do better than give complete condensation at atmospheric pressure for maximum loads with 70 deg. F. At higher temperatures there would, therefore, be either some exhaust to the atmosphere or back pressure. On the other hand, during periods of cool weather, vacuums might be maintained for all loads. For certain conditions, such as in northern regions, the air condenser might be best since all bother with condensing water would be avoided. Normally a better effect would be preferable. Provided an evaporative effect were added to an air condenser by providing water spray or drip pipes at the air inlet, a much higher heat transmission could be obtained with such an arrangement. Thus for 70 deg. F. and 60 per cent humidity, a vacuum of about 80 per cent at maximum load is attainable with about half the surface and half the air flow estimated as required for atmospheric condensation with a straight air condenser. There would be required a condensing effect of 28,000,000 B.t.u. allowing for regenerative heating, condensation, etc., for the maximum load and conditions assumed. Thin brass plate air condensers can be built to provide 50 sq. ft. exposed surface per cubic foot. For the above noted effect, it is estimated that an evaporative condenser of approximately 200 cu. ft. would be required. With water cooled surface condensation the condenser alone would require nearly as much space since it would need to be cylindrical, while the proposed design would be rectangular.

Apparently, therefore, a combined air and evaporative condenser would suit the conditions best. The space requirements would be less than for any other type. It would need less cooling water for any load and at times would require none. The auxiliary equipment required would be simpler in all respects. Proposed general arrangements are shown in Figs. 1 and 2, in which a combined air and evaporative condenser is included. It is located at the front, thus exposing its surface best to the air flow that would be induced by the train motion. The fan shown would thus normally act only as a booster and often would not need to be operated. However, this type of condenser is experimental and should be thoroughly investigated and tried out before it is included in any complete design whose arrangement would depend on its inclusion. Also the selection, size and location of condensing equipment would be influenced to some extent by the type of main drive.

Selecting a drive

Selecting a drive for locomotives operating at 800 lb. pressure and up is advancing into territory only partially explored. At present there are turbines operating at 1,200 lb. pressure and engines have been tested at 800 lb. and over. Apparently, therefore, a drive can be built that will operate. What limited experience there is shows also that where the conditions are suitable, the thermal efficiency is approximately what would be anticipated. This does not show what may be expected from the use of super-pressures for locomotives, though it indicates possibilities. The conditions of service are special and the equipment that can be used must suit the clearance limitations. Recent tests of the Schmidt-Henschel locomotive indicate a gain in economy. Just how much is due to the portion of power generated by the 850-lb. section and how much to other features is uncertain.

Turbine drive with gear transmission is now being used on several locomotives in Europe. The steam pressures are standard and a surface condenser with an evaporative recooler effect for the circulating water is included. Reversing* is effected by an auxiliary turbine wheel mounted on the main turbine shaft. This wheel, except when in use, runs idle in the exhaust chamber of the main unit. Apparently these locomotives have been successful in the service for which they were designed. They show some thermal economy relative to the standard cylinder drive. Presumably the boiler maintenance charge should be low due to condensate return. One large unit built recently has been equipped with two turbines so as to distribute the crank pin and rod stresses. There is no doubt that this form of drive can be used with high steam pressure. It is, in fact, reported that Fried. Krupp, A.G., Germany, has designs completed for a locomotive of this type to operate at 850 lb.

There are several general objections to using turbine drive with gear transmission. Gears have not proved entirely reliable in the past and probably will always have a high maintenance cost for the powers and ratios required. Again a geared turbine drive means a variable speed turbine. This means a throttled admission as well as uneconomic flow velocities of the steam for reduced speeds. This loss would be accentuated with high pressures. The steam economy would accordingly be poor except near full speed. In addition, the reversing turbine provided on the units built would not be satisfactory for general use as its economy and torque is low, and to provide full economic reversing effect would require a separate additional turbine.

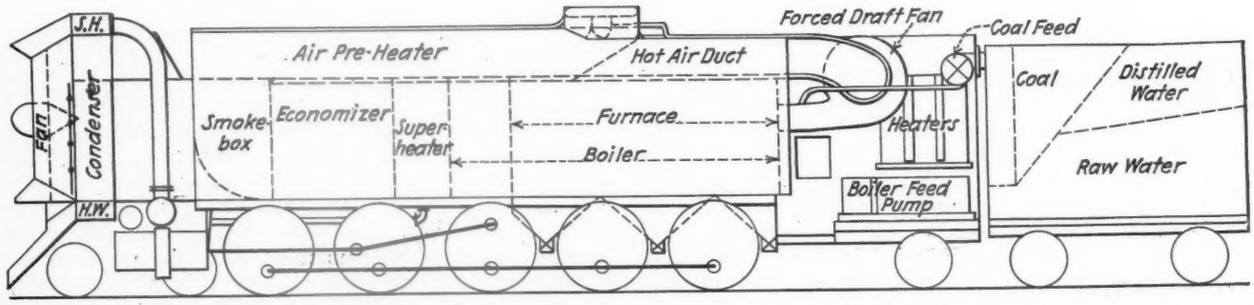


Fig. 1—Proposed arrangement for a compound three-cylinder drive

*See *Railway Mechanical Engineer*, December, 1926, page 727.

The turbine is fundamentally a constant speed machine. By using electric transmission in place of gears a constant speed turbine drive could be used. This arrangement would provide also full reversing effect without extra steam equipment. The motors can be arranged so that the driving stresses are distributed and the starting torque as high as is desirable.

Cylinder drive has advantages over any form of turbine drive in that no transmission is required. In addition, the steam economy of engines is better for the higher pressure range for a varying load. However, present types of locomotive cylinders are not fitted to utilize economically the high steam pressures. It seems probable that unaflow cylinders compounded could be built to give fairly good overall efficiencies. Reliefs would have to be provided to the steam chest and to the exhaust to take care of excessive compression and to give full starting torque. It might work out better to make the high pressure cylinder standard acting and only use unaflow construction for the low pressure cylinders. This arrangement would normally develop as a three-cylinder drive similar to present practice.

Since the cylinder drive has economic advantages for the higher pressure range and a turbine is better fitted to utilize low back pressures a combination of a high pressure engine with a low pressure turbine naturally suggests itself. This combination is common practice for stationary plants and has been used aboard ships. For locomotives it has certain advantages not found elsewhere, especially for pressures of 800 lb. and over. Thus, by the use of the low pressure turbo-generator electric drive, in addition to the high pressure cylinders, nearly as good distribution of driving stresses can be obtained as with complete electric drive, while the electric equipment needed will be only about one half. Furthermore, the thermal economy of this combination is very even, there being little difference in efficiency from say 30 per cent to 90 per cent maximum. With locomotives running at 50 per cent average load and varying constantly, this might make a considerable difference in fuel, water and size of heat absorbing equipment required.

It is very probable that each of the different forms of drive noted may best suit certain conditions. For passenger service with moderate power, no high reversing load and fairly high constant speeds, the geared turbine drive appears to fit in well. In this type of service its overall economy might be better than cylinder drive and its first cost would be lower than for any electric drive arrangement.

For heavy freight service with steep grades, either the constant speed single turbo-generator or the combined high pressure cylinder and low pressure turbo-generator drive would give an articulated arrangement with good variable speed high load economy. On all around service the fairly high economy and the relative simplicity of a compound cylinder drive appears to be best suited, especially where the power requirements are not large.

Two proposed designs

Two general arrangements are shown in Figs. 1 and 2. Fig. 1 indicates a suggested arrangement for a compound three-cylinder drive. Fig. 2 is proposed for a combined cylinder and low pressure turbo-generator. In the former arrangement a turbo-generator is included for driving the auxiliaries through electric transmission. Since this unit would be small in size it, as well as the feed pump and other auxiliaries, are assumed as carried in the cab back of the boiler. The combination arrangement has two trucks with the condenser, low pressure turbine and various auxiliaries carried on the front truck and the boiler on the rear. In this case the front truck would be motor driven and the rear, cylinder drive. The tender also could be made motor driven if more tractive force were needed.

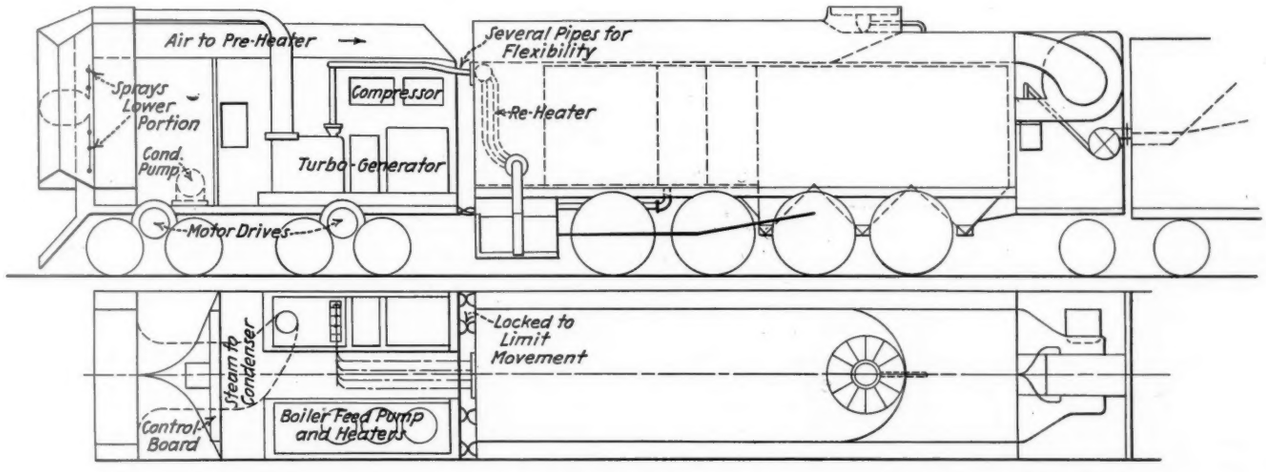


Fig. 2—Proposed arrangement for a combined cylinder and low pressure turbo-generator drive

In Fig. 3 is shown a diagram of connections for a combination high pressure, two-cylinder unaflow and low pressure, turbo-electric drive. It will be noted that three regenerative heaters and one reheater are shown. It is believed that this is about the limit in auxiliary heat equipment that could be advantageously used for locomotives. Whether as much would be justified would depend on various factors involving design, first cost, values of fuel, etc. The first impression would be that too much complication was contemplated.

With careful design it may prove that in reality the apparent complication will add to the reliability as well as to the economy of the whole. At present feedwater heaters of the closed type are normally used on locomotives and their function in aiding economy is understood. With the increase of pressure and consequently of temperature range, it is natural to increase the number of heaters in series or to approach as close to the regenerative cycle as is feasible. The addition of condenser effect besides increasing the thermal possibilities of regenerative heating increases the economic value in

that the added heater surface then replaces condenser surface as well as boiler surface otherwise required. Where injector heaters can be used, there should be a reduction in total volume requirements and first cost. With closed heaters there should be little, if any, increase. Heaters, when the feed-water is clean, should require little maintenance relative to the condenser and boiler surface replaced since they are exposed to only moderate temperatures and no low vacuum. Where the heaters are connected between stages of the feedwater pumps, as would always be the case for injector heaters, the pressures would also be relatively low.

To best utilize the high pressures proposed, involves provision for reducing the moisture content over the lower pressure range. By taking advantage of the reduced velocity in receivers between cylinders or of the centrifugal effect in selected turbine stages, it seems feasible to drain off a considerable portion of the moisture. Provided these drain points are the connections to the regenerative heaters, they would be especially effective due to the coincident steam outflow. In fact, the exhaust heater conditions would provide efficient drainage in place of less efficient and probably troublesome drips.

Reheating effect should entirely eliminate any possibility of moisture trouble as well as slightly increase the thermal economy. It is felt that normally the complication of the added equipment would not be warranted. With the combined cylinder and low pressure turbine arrangement shown in Fig. 3, the addition of reheating surface in the smokebox between the cylinder receiver and the low pressure turbine would require little additional space and could be made to line up with the steam flow. In this case, therefore, it would seem advantageous to provide for a moderate reheat. In the future it is probable that some form of reheater using, say, mercury vapor, may be developed that will be applicable to all designs of drive.

Auxiliaries

Locomotive auxiliaries are as a rule at present steam driven. They are rather inefficient in steam consumption and while reliable, require considerable maintenance work. The high pressures proposed, the burning of pulverized coal, adding a condenser and the form of boiler suggested would change the duty and nature of the auxiliary equipment. Boiler feed pumps would work against very much higher pressures, but would be required to handle relatively less fluid. The draft conditions would be entirely changed though the total work required should be less. Instead of a stoker drive, feed and crusher, only a feeding mechanism requiring little power would be needed. The condensing equipment added would include a fan and some small pumps. The requirements for electric lighting and compressed air would be the same as at present.

To drive the auxiliaries by high pressure steam would entail considerable high pressure piping and special driving units suited to the high pressures. Their efficiency would be relatively low. It is probable that all the auxiliaries could best be made the rotary type. A consideration of these features would naturally suggest motor drive. It is believed that this would be the best solution both economically and for reliability. On account of the speed control that would be required, direct current generation would be needed. No alternating current variable speed motor has yet been developed that is as economical and reliable. To make such a drive reliable, enclosed motors with forced filtered ventilation would be needed and the motors would need to be of rugged construction with characteristics suited to the duty.

With a turbo-generator main unit, the current for the auxiliary drive would naturally be taken from these units. Where the main drive uses a varying generator voltage control, a separate generator would be needed for the auxiliaries. This could, however, be mounted on the same shaft as the main generator. It is probable that with this arrangement a reserve steam driven unit should be provided. With geared turbine or cylinder drive a separate turbine driving a suitable generator would be needed. Such a turbine would be naturally high speed and would probably drive the generator through gears. Since the ratio and the torque would

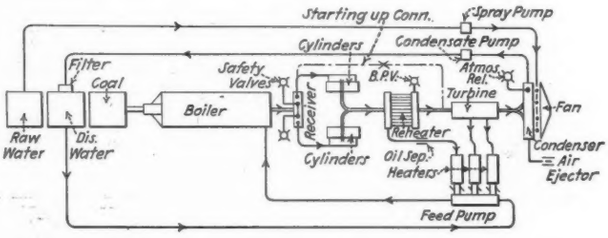


Fig. 3—Diagram of connections for a high pressure two-cylinder uniflow and a low pressure turbo-electric drive

both be relatively small, gear drive should be reliable. The turbine could in this case be arranged to take care of most of the regenerative heating required by bleeding suitable stages.

With the high pressures and the type of boilers suggested, the boiler feed pumps are a very important part of the equipment. Centrifugal multi-stage pumps are considered as best suited to the flow characteristics of the boiler and to the space limitations. They can be made reliable and since their discharge pressure is proportional to their speed, they can be readily controlled if provided with a suitable drive. In addition, they are suited to regenerative heating as the heaters can, if it proves desirable, be connected between selected stages.

At present draft is obtained by using the main exhaust as an air ejector. Since all steam is exhausted to atmosphere, the only waste is the increase in back pressure. With the turbine driven locomotives, steam turbine driven fans have been used. Maximum drafts required at present run up over 8½ in. A large portion of this pressure is required to overcome the resistance of the fire bed. With pulverized coal burning and the tubular boiler proposed in the preceding article, the draft requirements would be much less. It apparently would work out best to provide a forced draft blower for sucking the air through the air heater and forcing it through the burners and an induced draft fan to draw the gases through the heating surfaces. This arrangement would reduce leakage tendencies and could be regulated to give approximate atmospheric pressure in the furnace. In addition to the pressures required being less, the volumes handled by the fans would be relatively smaller due to the lower temperatures as well as the higher plant efficiency. The forced draft fan would naturally be a centrifugal blower. The induced draft fan on the other hand would probably have to be a turbine driven propeller type of fan on account of space limitations and temperature conditions. This draft equipment would work in very well with automatic combustion control.

The condenser fan should be some straight flow type, such as a propeller or possibly a double cone blower.

These forms of fans would utilize wind flow due to train movement. They would allow a fairly free flow of air through when the fan was at rest, and finally they could be balanced and thus run at very high speeds without local vibration. It seems probable that automatic control for this fan would not be warranted, but if desirable, the speed could be regulated by the condenser pressure.

All the suggestions advanced and the apparatus outlined in these two articles have been considered with a view to the economic returns that should occur from the use of superpressures for locomotives.

Traveling Engineers hold thirty-fifth convention

Meeting at Chicago notable for close attention to business—Instructive addresses and reports

ABOUT 550 members of the Traveling Engineers' Association registered at the thirty-fifth annual convention, held at the Hotel Sherman, Chicago, September 13 to 16, inclusive. One of the most striking features of the convention was the way in which these tures hovering constantly around 90 and 94. In spite of the discomfort the addresses and reports were listened to with keen interest, the latter being in almost all cases fully discussed. Second only to the technical sessions in interest and instructive value were the exhibits furnished

J. B. Hurley (Wabash)
President

J. D. Heyburn (St. L.-S. F.)
First vice-president

James Fahey (N. C. & St. L.)
Second vice-president

R. Hammond (N.Y., N.H. & H.)
Third vice-president

W. O. Thompson (N. Y. C.)
Secretary

men attended the sessions and took active part in the discussion in spite of the fact that the week of September 13 to 16 was one of the hottest ever experienced in the history of Chicago for that time of year, with tempera- by railway manufacturers and supply companies, of which 114 displayed their products in the exhibition hall.

The association was addressed by J. E. Taussig, president of the Wabash, who paid high tribute to the work

of the traveling engineers in their influence on improved railroad operation and consequently more favorable public opinion. R. H. Aishton, president of the American Railway Association, outlined the improvement in railroad operation secured particularly within the past 18 months, and also gave traveling engineers credit for a substantial share in this improvement. Mr. Aishton said that the Traveling Engineers' Association can be of great practical assistance to the American Railway Association if some form of organized co-operation between the two associations can be developed. In accordance with his suggestion, a contact committee, headed by J. N. Clark, general fuel supervisor, Southern Pacific, was appointed to work with such American Railway Association committees as the occasion seems to make necessary or desirable.

Other addresses favorably received by the traveling engineers were made by T. C. Powell, president of the Chicago & Eastern Illinois; George F. Hess, superintendent of motive power of the Wabash, and J. A. Shirley, representing A. G. Pack, chief inspector, Bureau of Locomotive Inspection, Washington, D. C. One session of the convention was devoted to a discussion of safety work led by Charles E. Hill, general safety agent of the New York Central. Reports were presented on the following subjects: More and better utilization of power, chairman J. M. Nicholson, fuel conservation engineer, Atchison, Topeka & Santa Fe; Value of back pressure gages and limited cut-off, Chairman A. T. Pfeiffer, road foreman of engines, New York Central; Recommended practice of air brake train handling, Chairman J. P. Stewart, general supervisor of air brakes, Missouri Pacific; Effect of water treatment on locomotive operation, Chairman W. A. Pownall, mechanical engineer, Wabash, and The Diesel engine, A. N. Boyd, road foreman of engines, Canadian National.

Election of officers

Just before adjournment at the closing session, the following officers were elected for 1927-28: President, J. D. Heyburn, master mechanic, St. Louis-San Francisco, Ft. Smith, Ark.; first vice-president, James Fahey, traveling engineer, Nashville, Chattanooga & St. Louis, Nashville, Tenn.; second vice-president, Ralph Hammond, road foreman of engines, New York, New Haven & Hartford, Providence, R. I.; third vice-president, A. N. Boyd, road foreman of engines, Canadian National, Montreal, Que.; fourth vice-president, H. B. Kelly, general road foreman of engines, Pittsburgh & Lake Erie, McKees Rocks, Pa.; fifth vice-president, J. M. Nicholson, fuel conservation engineer, Atchison, Topeka & Santa Fe, Topeka, Kans. David Meadows, assistant master mechanic of the Michigan Central at St. Thomas, Ont., was re-elected treasurer. Two new members were elected to the executive committee, J. P. Stewart, general supervisor of air brakes, Missouri Pacific, St. Louis, Mo., and J. N. Clark, general fuel supervisor of the Southern Pacific.

Report on locomotive utilization

In this report the committee outlined the fundamental requirements in securing more intensive use of locomotives and illustrated the report with three interesting charts showing the general improvement on about 30 individual roads from 1923 to 1927 in operation as regards (1) gross ton miles per freight train hour, (2) miles per active freight locomotive per day and (3) miles per active passenger locomotive per day. These charts, based on statistics issued through the American Railway Association, indicate in a striking way the improvement which is generally known to have taken place in these three phases of railroad operation in the past four or five years.

The report points out that formerly locomotives were idle approximately two-thirds of the time but that now "many railroads are making from 11,000 to 12,000 miles per month per active passenger locomotive, and from 5,000 to 6,000 miles per active freight locomotive by operating extended locomotive runs and giving careful attention to reducing the non-productive time to a minimum. In securing this mileage per active locomotive, the 24 hours of the day is divided into approximately 12 hours productive and 12 hours non-productive time. Further sub-division of non-productive time is divided into approximately eight hours for mechanical attention and four hours for transportation delay, awaiting trains.

"With ideal facilities for maintaining and turning power, it is a simple matter to speculate on what may be done in the way of turning power to secure a greater utilization, but the question of importance is how close may the maximum utilization be approached with the facilities now at hand. The character of business, type and size of power, terminal facilities, location of terminals, schedule of trains, quality of boiler feed water, quality of fuel, and profile of road are important factors which vary on different divisions and on different railroads, and have a bearing on the utilization that may be secured. These conditions make it necessary that all railroads analyze their own operation and conditions to satisfy themselves that they are getting the greatest possible utilization of their locomotives."

The committee called attention to the importance of adequate machine tools and other facilities at terminals, also the provision of repair forces organized where possible on a 24-hour basis so that locomotives which need conditioning operations can be repaired and returned to service with the least loss of time. The value of intelligent control of motive power use by local and division supervisors was emphasized. Regular reports, showing the average miles per active locomotive per day in all three classes of service as well as information in detail regarding the distribution of non-productive time, was said to be absolutely essential to this intelligent control.

The committee expressed the opinion that frequent exchange of information regarding power that will be ready and trains run is important since greater utilization of locomotives can be secured if roundhouse foremen know that certain locomotives in their terminals will not be used for 12 to 15 hours.

Regarding boiler washing, the committee said, "On many railroads it is necessary to wash boilers after each trip, or in some cases each round trip. The time required to wash boilers is usually the governing factor in time required to turn locomotives, which makes it important that this time be reduced to a minimum. Roads that have good water conditions, which result in less frequent boiler washings, may be expected to maintain a greater utilization of locomotives than roads operating in bad water territories."

An appeal for more intensive use of switching power was made as follows: "A more and better utilization of yard switch power is deserving of study to determine whether the greatest amount of service is being secured from the locomotives assigned. There are yards on many railroads where switch locomotives assigned average 16 hours' service out of each 24 hours, and as far as is practical, switch locomotives should be worked in the yards continuously during the tour of duty of two or three switch engine crews."

The committee closed its report with the following

comment regarding unnecessary stops, roadway equipment and the need of individual study of the requirements by each railroad.

"The delay to trains enroute over a division must be given careful thought to avoid every unnecessary stop. As far as possible trains should be run at the time of day when the least interference will be encountered. The leaving time of trains at terminals should be anticipated and the locomotives ordered and furnished promptly at the designated time. It is important that locomotives move from the enginehouse to the train yard, and from the train yard to the enginehouse with the minimum delay to locomotives, as well as the minimum delay to yard operation.

"The roadway facilities have an important bearing on the number of hours required to move trains from the initial to final terminals. Among the most important of these are the location of fuel and water stations, efficient blocking of trains, proper length of sidings, double track, facing point cross overs, adequate signaling, lap sidings, remote control switches, etc. With the establishing of extended locomotive runs, it is desirable to have fuel, water and sand facilities on the main line at intermediate terminals where such facilities will avoid having to take locomotives to the roundhouse for this attention.

"Any program which is worked out to increase the utilization of locomotives must give the greatest number of hours of productive service or mileage per month with the minimum terminal time undergoing repairs and delay awaiting trains. The hours of service or mileage of locomotives must be made to produce the maximum of useful work in order to secure the greatest return from the investment. A study of the operating conditions of each railroad may facilitate the movement of a considerably increased business without additional expenditure for locomotives or facilities."

(This report was signed by Chairman J. M. Nicholson, fuel conservation engineer, Atchison, Topeka & Santa Fe; C. J. Barnett, traveling engineer, Illinois Central; J. E. Bjorkholm, assistant superintendent motive power, Chicago, Milwaukee & St. Paul; Robert Collett, fuel agent, St. Louis-San Francisco; J. J. McNeill, supervisor locomotive operation, Erie Railroad; and F. C. Wenk, fireman instructor, Atlantic Coast Line.)

Discussion

In discussing this report, D. L. Forsythe, general road foreman of engines of the St. Louis-San Francisco, called attention to the notable performance of engine 4100 in completing two round trips in regular freight service between Kansas City and Birmingham, or a total of 2,940 miles with the same fire. A number of questions regarding this run were asked by the members and answered by Mr. Forsythe, who said that the Frisco is also securing intensive use of switching power, having 220 crews which work on two and three shifts. D. I. Bergin, Wabash, complimented the committee on its report and said that traveling engineers should study and become more familiar with transportation problems and keep the engine crews apace mentally with the improvement in modern locomotives. Robert Collett, fuel agent of the St. Louis-San Francisco, said that the first long run on the Frisco was made 22 years ago and that what has been accomplished since then has been made possible by the intelligent co-operation of traveling engineers. He said that enginemen are interested first, in safety; second, in their schedule, and after that, in the intensive use of locomotives, but he has found them willing to go along and all work together in the interest of improved service. James Fahey, road foreman of engines of the Nashville, Chattanooga & St. Louis, said that with proper coal there is no mystery about keeping fires indefinitely and that in one case a Pacific type locomotive on the N. C. & St. L. was operated 30 days without once using the dump grate. W. L. Robinson, fuel supervisor of the Baltimore & Ohio, said that nothing is more important than getting greater utilization out of locomotives. He called attention to the charts and the possibility of drawing erroneous conclusions by comparing performances on different roads, owing to the different physical conditions. Some roads, most carefully operated, cannot make the showing in gross ton-miles per train-hour or miles per active passenger locomotive per day that some other roads do. The number of branch lines, for example, has an important bearing on locomotive mileage and many other factors of local character make a comparison of the roads difficult. A great deal of time was given in the discussion of the committee's report to more intensive use of switching power and the general conclusion was that it was entirely practicable to keep switchers in 24-hour service, a practice which is being followed by a number of roads which results in economy.

Effect of water treatment

(The report of the committee was devoted to a consideration of the effect of water treatment on locomotive operation. Following a general outline of the different methods of treating boiler water to prevent the formation of scale, the committee listed the advantages and disadvantages of water treatment and quoted figures showing results accomplished.—Editor.)

Advantages of treated water

The advantages of treated water are listed as follows:

Reduction or practical elimination of failures due to leaking boilers.

Miles per engine failure due to leaky boilers: before treatment, 22,175; after treatment, 10,300,000; per cent reduction in failures, 99.8.

Reduced delays to traffic.

Increased life of flues.

Increased boiler efficiency.

Fuel and water saving.

Reduction in firebox and side sheet renewals. Firebox renewals per 100 engines per year: before treatment, 14.1; after treatment, 1.0; per cent reduction, 93.0.

Reduction in staybolt breakage. Staybolts broken per engine per year: untreated division, 54.3; treated division, 1.2.

Arch tubes seldom burned.

Increased time between boiler washings.

Time saved and more engines available for service, because of fewer boiler washings, fewer engine failures, and less time in shop and enginehouse.

Long runs by locomotives made easier.

Reduced pitting of boilers.

General decrease in cost of boiler repairs.

On a division using a poor quality of water untreated the proportion of boiler repair cost to total locomotive repairs cost was 37 per cent, whereas the best performance of the treated division showed boiler repairs costing 9 per cent of the total. The difference of 28 per cent is an indication of the maximum possible saving in boiler costs due to water treatment.

Time and miles between flue resettings—best performances

	Freight		Passenger		Switch	
	Time	Miles	Time	Miles	Time	Miles
Before treatment	15 months	45,000	18 months	90,000	24 months	45,000
After treatment	54 months	200,000	58 months	350,000	58 months	150,000

Days or trips between boiler washings or water changes

Freight		Passenger		Switch	
Before treatment	After treatment	Before treatment	After treatment	Before treatment	After treatment
5 days	30 days	Two round trips	30 days. Change water every four round trips	7 days	30 days

Disadvantages of treated water

The disadvantages of treated water were listed by the committee as follows:

Foaming, if permitted.
(a) Waste of fuel and power.
(b) Decreased amount of superheat.
(c) Suspended solids carried into superheater units.
Waste of fuel and hot water at low blow-off cock.
Fuel wasted at washout or water changes. (This will be a saving instead of a loss if washout period is increased.)
Limed up branch pipes, injectors and boiler checks.

The words "if permitted" are added after foaming because it is felt that with proper organization and a full understanding of the situation by enginemen and all who have anything to do with handling the treated water, foaming can and should be avoided in practically all occasions. The above mentioned disadvantages in connection with foaming would then disappear.

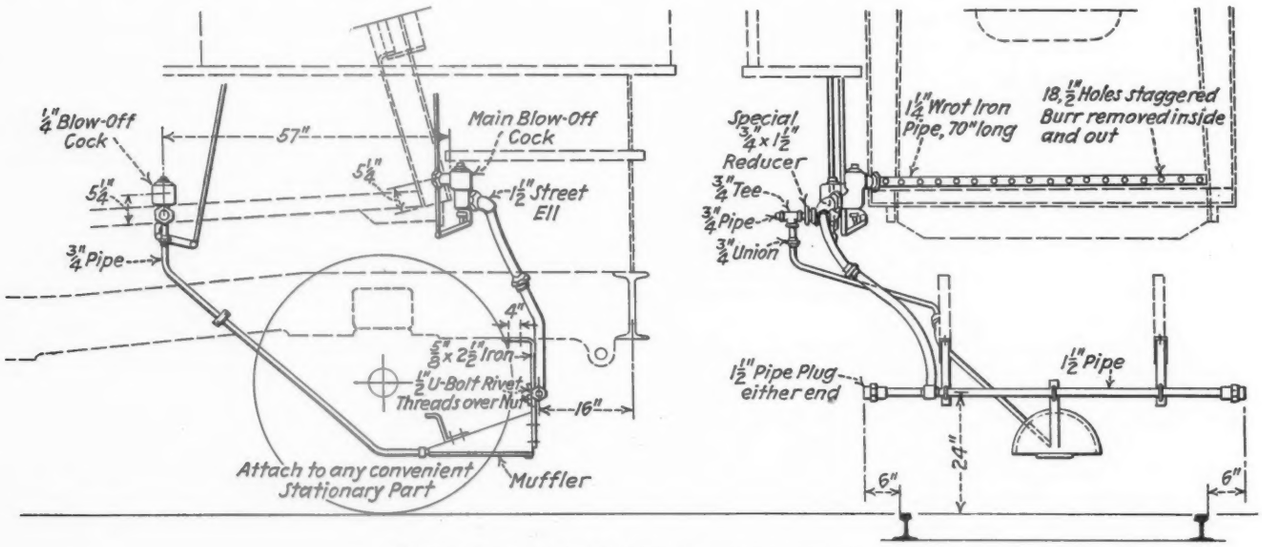
All waters have enough dissolved or suspended matter in them so that sooner or later as they become concentrated in the boiler the water will have a tendency to foam. This foaming tendency is usually increased by the addition of any treating chemicals. There is still a division of opinion as to whether foaming in the boiler is caused by the dissolved solids or alkali salts, by the suspended solids, or by the dissolved solids in combination with the suspended solids. No attempt will be made to discuss the pros and cons of this matter, but it is pretty definitely known that with any form of treatment which does not remove the hardness before water enters the boiler the foaming tendency of the water can be fairly closely measured by the amount of dissolved solids in the water in the boiler. This is also true to a certain extent with any form of water treatment, although it may be that where the treatment is sufficient to reduce suspended solids in a boiler to a minimum, the concentration of dissolved solids at which the boiler will foam may be somewhat higher. In any event the foaming results when a concentration occurs in the water in the boiler. To avoid this foaming condition a portion of the concentrated water in the boiler must be removed via the blow-off cock, and replaced with fresh water, in this way reducing the concentration. This exchange of bad for good water through the blow-off cock must be done as often as water conditions on the particular operating division demand, and in order to keep below the foaming concentration. This relief of the foaming condition may be accomplished from time to time by means of blow-off cock or may be accomplished by complete change of water at the engine terminal. The concentration at which foaming will occur may also be materially increased through use of anti-foaming compounds, which may either proportionately reduce the amount of blowing off necessary or make it possible to do without the use of the blow-off cock under certain conditions providing there is a preference towards frequent changes of water or boiler washings at the engine terminal rather than using the blow-off cock. The economy of this practice will be discussed later.

The control of the foaming tendency is, therefore, in most instances entirely dependent on the sufficient and timely use of the blow-off cock. Proper application of the blow-off cock will be first considered.

Blow-off cock and application

When treated water is used, frequent use of the blow-off cock will be necessary. A type of cock should be selected which is least susceptible to leaking under heavy service, and which will be readily accessible in case repairs are necessary. The shut-off type of blow-off cock, by means of which the hot water from the boiler may be shut off while the main blow-off valve is being ground in or repaired, is a type that might prove desirable where conditions are such that even a good blow-off cock entails frequent repairs. Where any form of treatment is used which does not remove the hardness before the water enters the boilers, but which so affects the incrusting solids that they do not adhere to the heating surfaces, it becomes desirable to locate the blow-off cock so as to remove the maximum amount of sludge every time the blow-off cock is opened. Critical examination of the deposits in the locomotive boiler shows that scale accumulations are greatest along the belly and in the front throat sheet, and the softer material is deposited along the side water legs and in the back water leg, the largest deposit being in the back water leg under the fire door. This condition is brought about through conditions of circulation in the boiler.

The greatest sludge accumulation is on the back mud ring, and it is, therefore, advisable to locate the blow-off cock so that it will remove this back water leg accumulation of sludge. If this accumulation is removed by use of the blow-off cock, the sludge on the sides will immediately work back, relieving the condition along the side



Blow-off cocks and piping—Passenger engines

legs. An effective arrangement consists of a blow-off cock in the left back corner and connected to a perforated pipe which lies on the back mud ring. It is important not to have too many perforations in this type, otherwise the sludge will only be removed from part of the back water leg instead of cleaning out the entire space. This method of blowing off locomotive boilers is considered almost a necessity in connection with any form of treatment which does not remove the scale forming material before it enters the boilers.

A blow-off cock located near the front throat sheet, and drawing through a system of perforated pipe from the front mud ring and along the belly of the boiler may have considerable merit in removing mixtures of mud and scale which are deposited in these places where the water treatment has not been such as to prevent scale formation completely.

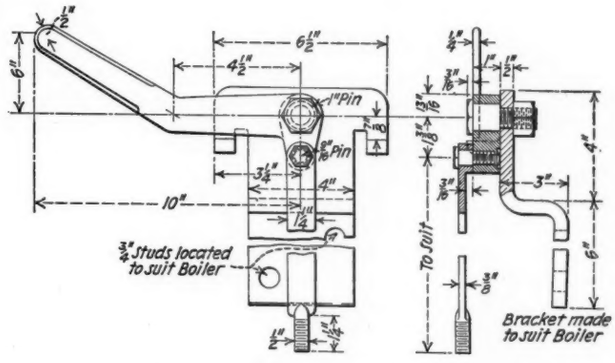
There is a question as to whether the right or the left side of the boiler is preferable for the blow-off cock location. The committee feels that it should be located on the left back corner and operated by the fireman. There are usually less appliances obstructing the application of the blow-off cock on the left side than on the right.

Method of holding the blow-off cock open

Some types of blow-off cocks have to be held open by the enginemen, and at times it becomes desirable that the blow-off cock be held open from two to three minutes at a time. Two of the illustrations show an arrangement by which the blow-off cock can be opened with slight effort, and held open until the lever is returned to its original position by the enginemen.

Small blow-off cocks

Some railroads using treated water are making use of a blow-off arrangement wherein a small amount of water may be discharged continuously for as long a period as desired, while the engine is in motion. This usually consists of any standard blow-off cock fitted with a bushing with a hole ¼ in. in diameter, and which will ordinarily discharge about 600 gals. of water per hour, or the equivalent of a full glass of water. The discharge from the blow-off cock is piped into a muffler and the discharged water drops on to the track without any noise or without spattering equipment. This appliance is used, as a rule, only on passenger engines, and provides enginemen with an excellent means of easily relieving any foaming tendency which may develop enroute. Instead of using a standard blow-off cock, a ¾ in. angle globe valve may be used with a ¼ in. diameter choke between the valve and the boiler. Another illustration shows a ¼ in. blow-off using a standard blow-off cock, and located near the mud ring at a point where it removes sludge in addition to removing the concentrated water.

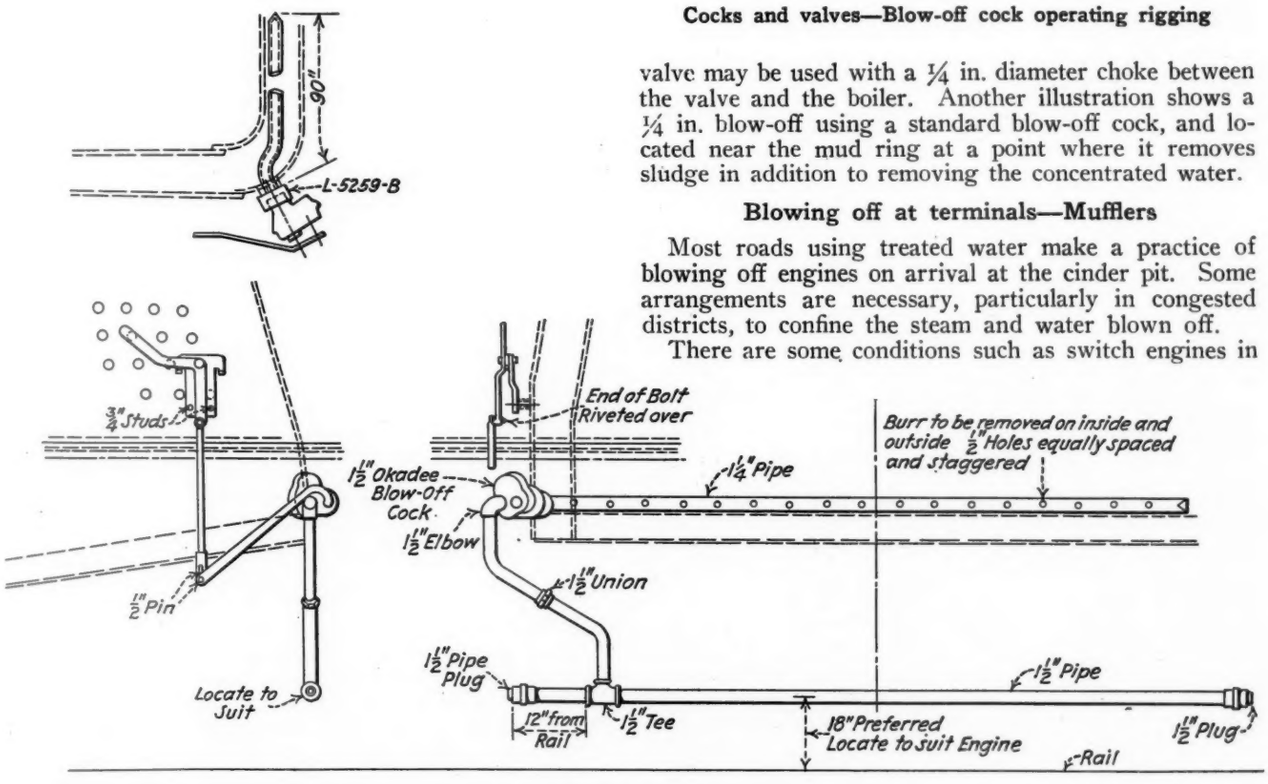


Cocks and valves—Blow-off cock operating rigging

Blowing off at terminals—Mufflers

Most roads using treated water make a practice of blowing off engines on arrival at the cinder pit. Some arrangements are necessary, particularly in congested districts, to confine the steam and water blown off.

There are some conditions such as switch engines in crowded terminals or road engines running in densely populated districts where it is difficult to find opportunity to blow off engines without whitening adjacent property or equipment. This difficulty is overcome by the use of a muffler applied to the end of the blow-off pipe. Mufflers are also used in connection with the ¼ in. blow-off cock described above. Where the main blow-off cock is used through one of these mufflers the hot water will be discharged down between the rails, and there will be more



Blow-off cock arrangement

or less steam surrounding the engine if it is standing still, but if it is moving this steam is dissipated and is not objectionable. If it is the practice to blow off engines into hot water washout system at the engine terminals, it is necessary where a muffler is used to provide a by-pass pipe with necessary valves so that the muffler can be shut off. A commercial blow-off muffler which gives satisfactory service is that developed on the Kansas City Terminal.

Organization and instructions

It is felt that one of the most important features in connection with the use of treated water is the campaign of education, and particularly preliminary to starting the use of treated water, among enginemen and all others that are in any way concerned with the operation of trains, and locomotives. It has been not uncommon experience to have water treatment get in very bad repute and even be abandoned on account of the delays on the road caused by foaming engines at the time treatment was started, which could have been avoided if the enginemen had been sufficiently educated in advance as to how to handle the situation successfully.

The preliminary education campaign should start first with the road foremen and master mechanics, and the road foremen should then transmit information relative to treated water and how to handle it to all enginemen and obtain acknowledgment, and the matter should then be discussed in meetings before treatment is started. After treatment has been in effect there will always be plenty of discussion at meetings attended by the enginemen. Fuel meetings have proved to be an excellent occasion for discussing water treatment.

The amount of blowing off necessary to control foaming varies considerably with the quality of the untreated water, and the amount of treatment added, and it is difficult to formulate any definite set of instructions. The committee realizes that in some districts the water conditions and the treatment are such that engines may be handled successfully with very little use of the blow-off cock, but our investigations indicated on a railroad where waters over a division are treated, successful handling of the situation depends entirely on the proper use of the blow-off cock.

(The committee here included examples of typical letters of instruction to enginemen relative to blowing off.—Editor.)

Enginemen when first coming in contact with the treated water situation, even though they have had considerable advance information as to how to handle the situation, will frequently find themselves with a foaming boiler and sincerely believe that they have done all possible to prevent the foaming and that the situation is beyond their control. The best way to handle cases of this sort is to have dispatchers instructed when report comes in that engine is foaming and cannot handle the train, to have the train take siding, and road foreman will be sent out to show the enginemen how to put his water in a non-foaming condition and handle the train successfully to the terminal. A few cases handled in this manner have a very beneficial effect as they are discussed freely among enginemen, and the foaming trouble soon becomes a thing of the past.

Waste of fuel and hot water

Whenever the blow-off cock is open, a certain amount of heat is wasted to the atmosphere, and it is thought by many that this waste of fuel and water is excessive and even prohibitive. There is no question but what this is a waste, but the amount of fuel and water wasted in this manner can be definitely measured. It constitutes an important part of the cost of treating water. The fuel wasted under average conditions may be 1½ to 2 per cent of the total fuel used. Although the cost of this fuel wasted is considerable, it is far outweighed by the many financial benefits derived through the use of treated water. Moreover under average conditions it will be found that this fuel waste constitutes less than it would cost to change the water or wash the boiler in the engine-house at fairly frequent intervals.

The fuel wasted at the washout or when water is changed, is shown as one of the disadvantages of treated water in event proper use of the blow-off cock is not made and frequent water changes and washouts are resorted to. Under average water conditions it is possible very materially to increase the mileage between boiler washings or water change. The cost of blowing off is less than water change or boilerwash so that there is really a saving to be had instead of a loss under this heading.

Limed up branch pipes, injectors and boiler checks, is not a common trouble incidental to the use of treated water, and probably should not be included as one of the disadvantages. It is a trouble, however, that sometimes occurs, and can possibly be traced in some cases to improper water treatment.

Conclusion

The committee is mindful of the fact that there are extreme conditions where blowing off will not control foaming, where it is necessary to use anti-foaming compound in combination with the blow-off cock, and where even the frequent washouts or water changes are necessary in order to operate an engine successfully from one terminal to another. This is a matter, of course, which must be decided for each individual engine operating district, and even under these conditions it is possible to operate the engine without foaming trouble. In addition to insisting on proper education and supervision of enginemen in the matter of operating engines under treated water conditions, we want also to emphasize and urge proper supervision of water treatment with a competent organization to handle it.

The report was signed by chairman W. A. Pownall, mechanical engineer, Wabash, Decatur, Ill., H. B. Kelly, general road foreman of engines, Pittsburgh & Lake Erie, McKees Rock, Pa., J. W. Wells, road foreman of engines, Nashville, Chattanooga & St. Louis, Ft. Wayne, Ind., W. L. Robinson, superintendent of fuel and locomotive performance, Baltimore & Ohio, Baltimore, Md., and F. E. Keenan, district road foreman of engines, Southern Pacific, Sacramento, Cal.

Discussion

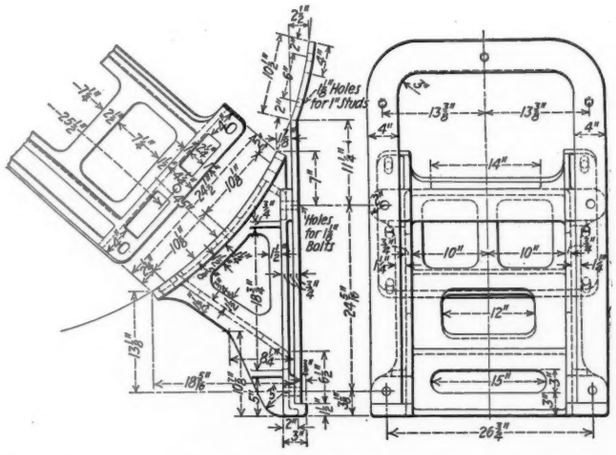
In discussing this report, a number of members emphasized the fact that unless blow-off valve handles are placed within convenient reach of the enginemen, they will not be used to any extent. It was pointed out that the frequency, rather than the amount of blowing off, is the factor which prevents locomotive foaming. D. I. Bergin, Wabash, expressed the opinion that in general, locomotive crews are not given enough information regarding the amount of water which must be blown off to reduce the concentration of solid matter and prevent foaming. He advised letting engine crews know the per cent of water evaporated which must be blown off. He also recommended terminal blowing, properly handled, as a real assistance in lengthening washout periods. C. F. Willoughby, Pere Marquette, reported favorably on the results secured with wayside treatment but said that good results are also being secured on the Pere Marquette with internal treatment. He favors intermittent

blowing at five-second intervals and said that the scientific blowing-off of water on the Pere Marquette has resulted in a marked improvement in boiler condition to such an extent that 38 out of 227 locomotives are now due for complete removal of flues after a service of four years, whereas formerly 14 to 15 months was the limit between flue renewals. Mr. Pownall closed the paper with the statement that the proper internal method of water treatment will prevent formation of scale, and little trouble will be experienced with stopped up superheater units. He said that the short blow-off method, mentioned by one of the members, will be successful only when enough water is blown out to reduce the concentration the required amount. He expressed the opinion that the Kansas City Terminal's muffler*, mentioned in the report, fully satisfies the need for a device for blowing down locomotives in crowded industrial districts.

*This muffler was described on page 64 of the January, 1927, *Railway Mechanical Engineer*.

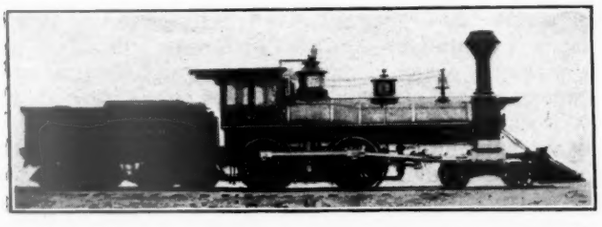
Support for locomotive air compressors

THE air compressor support shown in the drawing is applied to a number of 4-8-2 type locomotives on the Louisville & Nashville. It is of cast steel and



Air compressor support used by the Louisville & Nashville on a number of its 4-8-2 type locomotives

only the outside bearing surfaces and the top of the bottom lug on which the compressor bracket sets are finished. All bolt holes are drilled.



Columbus & Toledo locomotive No. 57 built in 1880—Diameter of drivers, 57½ in.; 16-in. by 22-in. cylinders; 4-ft. 9-in. gage

Locomotive repair record

LOCOMOTIVE 1421, built at the Illinois Central Weldon shops, Chicago, in April, 1891, gave effective service for a period of over 35 years and was retired in August, 1926. During this period the locomotive, which was of the I. C. suburban 2-4-4 type, burned 57,680 tons of coal, evaporated 222,538 tons of water and made a total mileage of 1,198,125. The total cost of shop repairs during the life of this locomotive was $46,772.35. Two break downs were experienced, one in 1893, when a crank pin broke, and another in 1898, when both main drivers broke off the axle.

Mileage and cost of shop repairs of an Illinois Central suburban locomotive

			Cost for Repairs	Mileage
April	1891	In service	.....	.....
January	1894	General repairs	$1,288.19	107,100
March	1895	Light repairs	167.38	.....
August	1895	General repairs	790.09	.....
February	1900	General repairs	1,551.09	147,000
November	1902	General repairs	2,044.76	88,138
April	1905	General repairs	1,770.02	83,945
October	1905	Light repairs	109.31	.....
December	1905	Light repairs	263.34	77,677
September	1907	General repairs	2,076.78	.....
April	1909	Light repairs	312.75	79,401
October	1909	Light repairs	137.40	.....
April	1910	General repairs	2,248.10	.....
May	1912	General repairs	2,123.95	73,644
September	1912	Light repairs	560.04	.....
November	1912	Light repairs	102.68	69,458
July	1914	General repairs	3,225.42	.....
April	1916	Light repairs	289.29	.....
May	1917	General repairs	3,600.60	78,035
January	1920	General repairs	5,370.01	77,120
February	1922	General repairs	9,533.72	62,466
February	1924	General repairs	6,299.12	71,710
February	1925	Light repairs	184.97	32,483
June	1925	Light repairs	141.91	10,601
August	1925	Light repairs	210.46	5,858
November	1925	Light repairs	1,870.27	6,492
February	1926	Light repairs	500.70	.....
August	1926	Retired from service	.....	22,497
			$46,772.35	1,198,125

A LOCOMOTIVE OF 1847.—The bronze model of a locomotive which for 75 years has surmounted the clock on the granite passenger station of the Fitchburg Railroad on Causeway street, Boston, has been taken down and polished and installed over the

Model of the "Alvah Crocker" over the entrance to the general office building of the Boston & Maine

entrance to the new general office building of the Boston & Maine.

The model is about 5 ft. long and is believed to be a fair representation of the "Alvah Crocker," one of the early locomotives of the Fitchburg road. It had stood on the "castle" at Causeway street since May 26, 1847, which was the year in which the building was finished.

Apprentice picnic at Parsons, Kan., Missouri-Kansas-Texas

Railway trades training*

The Missouri-Kansas-Texas has gone well outside the beaten path in its apprenticeship program

By T. C. Gray
Supervisor of apprentices, Missouri-Kansas-Texas Lines

AMONG many reasons why our railroads should be greatly interested and concerned with this problem of apprentice training there are three that stand out vividly. Industry should be interested in trades training, because: (1) Of the many obligations it owes society; (2) it offers an ideal method of recruiting, training and building a future personnel, and (3) it is good business.

When it was decided that we reorganize our apprentice system, we first set down the things that we desired in our finished product. We wanted each apprentice to be: (1) A good and useful citizen; (2) interested; (3) habitually busy; (4) skillful; (5) Educated—technically, as to the importance of safety and health, as to the necessity of thrift, to understand the value of proper recreation, socially; (6) happy; (7) physically qualified.

Our philosophy of apprentice training may be sifted down to the following ideals and functions of our training plant: (1) The selection of material for the plant; (2) the proper training of this material, (a) character development, (b) manipulative skill development, (c) information development; (3) the placing of the finished product.

Selection of apprentices

As our training system has improved we have been favored by a larger number of applicants. By cooperating with our local high schools and by maintaining a high standard of apprenticeship we have found that the majority of our applicants are now graduates of accredited high schools. In the past few years we have examined a great many applicants and found, in a good many cases, that a boy who made a good impression on us and had the high school education back of him did not always make us a good boy.

We decided to try out several psychological tests with the idea of determining the difference in reaction between our exceptional material and our mediocre material. With this object in view and with the help and co-operation of the Kansas State Teachers' College, we administered several different kinds of tests to two of our apprentice schools. A representative of the Teachers' College administered the tests and the results were computed and tabulated by the psychology department of the college. Neither the man who administered the tests nor the men who tabulated the results were familiar with the standing of any of the apprentices and, in fact, the latter group had never been associated with the boys in any manner. While the process of scoring the tests was under way, we made a very careful study of the boys who were subjected to the tests and made an effort to rate them as regards this shop and school ability and attitude. We found that our rating was startingly near identical with that of the Teachers' College.

We have been using the Otis test now for nearly one year and although this is a comparatively short time, we feel that it has helped us select some mighty fine young chaps. We do not regard it as conclusive but do believe that it is indicative. We also give our applicants a test in arithmetic which demands a very good foundation in common school mathematics. After surviving both the arithmetic and intelligence tests, the applicant must fill out an apprentice application blank which includes the personal data found on the conventional form of this type. He is then drawn into a conversation and asked a number of leading questions dealing with his personal history, home training, social characteristics, abilities and his likes and dislikes.

If the applicant's rating is high and he is chosen to

*Extracts of an extensive paper on this question which was read by Mr. Gray at the meeting of the New York Railroad Club, Friday, September 16, 1927.

enter our apprentice system, he is given a rigid physical examination by a company physician. He must then report to the apprentice school and there he learns, from the apprentice instructor, of the rules that he must respect, of the importance of his observing all safety rules and precautions, of our association of shop employees, of the apprentice club, and of the traditions and ideals of the railroad. He is told of the obligations that he is about to assume and is given an Apprentice Manual which explains our apprentice system and its ideals. He must then complete an indenture, fill out a regular application form, and is then ready for his first assignment.

Apprentice board

We have an Apprentice Board in each shop. It is comprised of the shop superintendent, who acts as chairman, and his departmental foreman. The board meets once each month after shop hours and all of its members are very active in bringing out all matters pertaining to apprentices. Our new boy is brought before the board at its first meeting after he has started his apprenticeship and introduced to each of its members. The board congratulates him upon being taken into the "Katy family" and assures him that the members of the board are his friends and willing to assist him at all times. They tell him of the importance of his making good grades both in the shop and in the school and urge him to make the most of his apprenticeship. He is told that his first six months is a probationary period and that at the completion of this period he will again appear before the board to either be dropped from service or to be congratulated and retained on account of his good record.

In order that we train our material successfully, we must have a clear understanding of *what is wanted*. We must know all of the things that are required of the mechanics in each of the trades. This list will be an analysis of the things that our product must *know how to do* when he has completed the training period. We made a very careful and thorough analysis of our 14 railway trades. The analysis of the machinist's trade alone included over 500 items and indicated the operations that we wanted our product to be able to perform when he had completed his period of training. With this analysis as a basis, we designed our shop routine in a sequence of interest and difficulty and in such a way as to keep our material busy from the first day to the last of his apprenticeship.

No shop apprentice instructors

The instruction in the shop is of vital importance and depends upon those concrete items that are included in our trade analysis. Some systems use shop instructors. This would be an ideal plan if: (1) The shop instructor was not held responsible for any part of the shop production. (2) The shop instructor had no more boys than he could rightfully instruct. (3) The boys in each trade were cared for in this manner. (4) The various shop instructors *know* the things that the boy should *be able to do* when he had completed his period of training.

As a general rule the shop apprentice instructor is a sub-foreman and is responsible for a certain portion of the shop production; he is a machinist and knows very little about the other trades. There are a great many conflicts between him and the other foremen, and we are of the opinion that it is more ideal to have all of the foremen "sold" on apprentice training and absolutely interested in the boys under their supervision.

When a shop apprentice instructor is used the foreman is apt to feel that the problem of instruction is entirely in the hands of the instructor. Interesting the foreman is much easier written than accomplished. It requires an educational movement to get all of the foremen to really appreciate the value of apprentice training and to make them understand that instruction is a part of their obligations and duties. A good foreman should have some ability as an instructor. There is a tendency on the part of some foremen to look lightly upon this part of their job. However, it is difficult to think of a case where men are placed on new work that a certain amount of instruction is not necessary if the man is to do all that is expected of him. Each foreman should be furnished with a list of the things the apprentice should learn how to do relative to the work of his particular department, and should also be familiar with the work in the school relative to his particular department. He should be interested in the school and visit classes frequently and keep in touch with what *his boys* are doing and how they are getting along.

Instruction is surely a part of the supervisor's obligations and duties. The supervisor may be brought before the apprentice board as well as an apprentice, and told that he is "falling down" in the fulfillment of his obligations to the apprentices in his department. The system of having each shop supervisor function as a shop instructor has proved more than satisfactory on our lines. However, the foreman must realize the importance of keeping the boy busy at all times and must command the utmost respect from the boy to get the most good from his product.

Each foreman submits a monthly report on each apprentice under his supervision. This report is approved by both the general foreman and shop superintendent, before being passed on to the school. This report indicates the boy's name and trade and lists the experience that he has had during the past month. It shows his shop grade for the "past month." The grade that he receives is not based entirely upon his manipulative skill but more upon the following factors:

Attitude ..... Rational? Interested? Optimistic? Self-controlled? Persistent?
Mental Calibre.. Accurate? Systematic? Alert? Concentrate? Quick to learn?
Judgment ..... Common sense? Observing and reasoning power? Foresight? Resourcefulness?
Character ..... Dependable? Reliable? Absolutely honest? Loyal? Clean? Responsible? Just? Courageous?
Effort .....Is he a hard worker?

The report also has a space for the foreman to make any suggestions about the boy or his shop or school work. A grade of "C" or lower indicates that the boy is on "thin ice" and he is brought before the Apprentice Board, and the reason for his low grade is determined. The foreman may be at fault or the boy may have developed some physical handicap, such as defective vision. Three consecutive grades of "C," after the boy has been warned, automatically severs his relationship with the company. These three grades of "C" may have been obtained in either the shop or school, or both.

Apprentice clubs

Our foremen are members of our apprentice clubs and attend the majority of their meetings. A portion of each apprentice club meeting is set aside for a discussion of the previous month's locomotive performance. This is carried on in the nature of a mock master mechanics' meeting. The apprentice instructor acts as mechanical superintendent and the apprentices are his master mechanics. Apprentices are assigned various failures and must prepare any sketches necessary to explain the failure fully before the club. The parts that have failed are sometimes available for exhibition. Some

very interesting and lively discussions have resulted from this practice and we regard it as one of the best steps, from an educational standpoint, that we have taken. It makes the boy more conversant with his obligations.

School training

The school training deals with the informative side of the trade and its function is to supply the boy with the things that he should *know* when he has finished his period of training. The success of a trades training system depends upon four factors: (1) The kind of system used. (2) The material from which the finished product is produced. (3) The training facilities. (4) The co-operation and backing of the management. Lacking any of these, the system can not be successful.

It is very common sense reasoning that tells us that the boy's interest in the school will lag if he can see no direct relation between the shop and school work. The studies in the school should have a direct bearing and relation to the actual shop work. This principle is of prime importance and we have made every effort to have our shop and school work go "hand in hand."

A critical analysis told us that we were to diverge from the beaten apprentice school path that has been followed by the majority of the larger roads for the past 20 years. For example, mechanical drawing monopolizes the apprentice school time of the boy in most systems. Our schedule, based upon our analysis, calls for four per cent of his time on mechanical drawing and 10 per cent on shop sketching. Where the majority of apprentice schools show intricate mechanical drawings and beautiful drawing tools to their visitors, we point with great pride to a sketch made on a piece of shop scratch paper with the aid of a greasy two foot rule. Sixty-one per cent of the time that our apprentice spends in class is taken up by what we term parallel work. By parallel work we mean work in the school that correlates the actual work that the boy is doing in the shop.

When the apprentice attends his class he finds his work for this period all laid out on his permanent desk. At the completion of the period the work is left on the desk and gathered up by the instructor who grades it and has it back by his second session. He is given the work that he is supposed to complete in that period. He must keep busy every minute if he expects to keep up with the schedule. Grades are given on all work and all work in the school has a time limit and the boy is allowed only the number of hours assigned to a subject in the school. After the scheduled time is completed, he is ready for another move in the shop and is given the corresponding assignment in the school. If he failed to complete the first assignment, this must be completed on his own time and accepted by his instructor before he is graduated. A progress record is kept in the school which shows at a glance what sort of record the boy is making. This record is similar to our shop routing boards and tends to keep the boy "on time" with his work. He is made to realize early in his training period that his chances of advancement vary directly with his application and attitude.

The instruction must be of the individual type as there are no two boys with the same service credit. There are several different trades represented in each class. The success of the apprentice class depends upon the interest, ability and personality of the instructor. He should attend strictly to his class when it is in session and not devote the major portion of his time to some special work. He should spend some time with each apprentice during each class and should not have over 15 boys in a class. His attitude will be somewhat of an influence on the apprentices. Their interest will lag if he does not show them that their problems are his problems. In grading their work he must examine it closely and conscientiously grade each question, problem, or sketch.

I do not believe that I can say too much about the importance of discipline. We are very strict in our apprentice classes and also with our boys in the shop. In the class room they must be at their permanent seat and busy when the whistle blows and they are not allowed to even whisper to one another during a class session. They are made to realize early in their apprenticeship that they are in the shop and in the school for work and that serving an apprenticeship is a man's job. It is important that the instructor be one who has "gone through the mill" himself and he should have a good technical education. He must realize *what is wanted* and realize that his position is such that it demands constant study and alertness on his part if the product is to be of maximum efficiency. All of our classes are held the first thing in the morning when the boys' minds are fresh.

Education on safety and health, on recreation and social attitudes and thrift is carried on by personal contact, by examples, and by inspirational addresses before the apprentice club meetings. We plan to bring our apprentices together once or twice a month beside their regular apprentice club meetings for educational talks dealing with the character side of their training. We send delegates to the Younger Men's Conference sponsored by the Y. M. C. A. and each year hold a mock conference in which the "high spots" of the Younger Men's Conference are touched. We have held several system conferences in which our apprentices have heard talks on the mechanical department and its obligations; on the transportation department by our vice-president and general manager; on public relations by our manager of public relations and assistant to the president.

We feel that these educational movements have been just as important as the manipulative and informative training. It has served to give our boys a new outlook on life and its possibilities. It has given them a new slant on their jobs as "men" and made them realize better their many obligations to society.

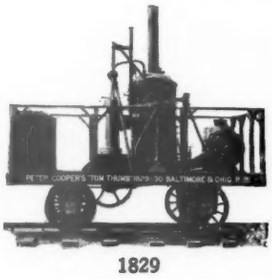
Placing finished product

The apprentice instructor should inform the chairman of his Apprentice Board when an apprentice is nearing the completion of his training period. This information should be in the form of a report showing a complete record of the boy throughout his course. It should show the experience that he has had in the shop, the work that he has completed in the school and the grades that he has made on each shop and school assignment, and an average grade. The report should include a rating on the boy's effort, attitude, mechanical ability, common sense, health, leadership ability, self-reliance, morals, and mental calibre. It should show the interest that he has taken in the apprentice club. This interest would be reflected from the offices that he has held, from his participation in athletics and from his interest in the various discussions. The form should indicate the placing for which he is best qualified. The boy should be called before the next regular meeting of the Apprentice Board and given an oral examination with the board functioning as an examining board. At their next regular meeting the board should decide what disposition should be made of the boy. The boy should understand early in his apprenticeship that the interest that the board will show in his graduation report depends upon his average grade and this average grade is a function of his application and attitude.

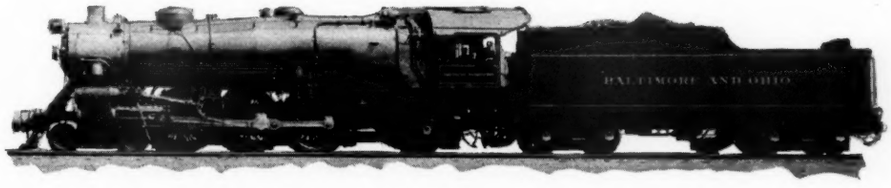
Exhibition grounds viewed from the platform at Halethorpe station

The fair of the Iron Horse

Some views of the B. & O. centenary exhibition and pageant which is being held at Halethorpe, Md., September 24 to October 12



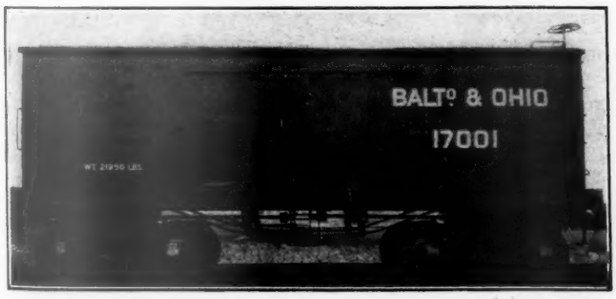
1829



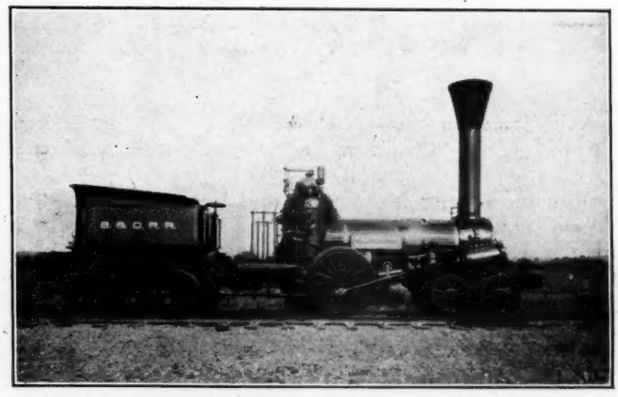
1927

The "Ross Winans"—1869

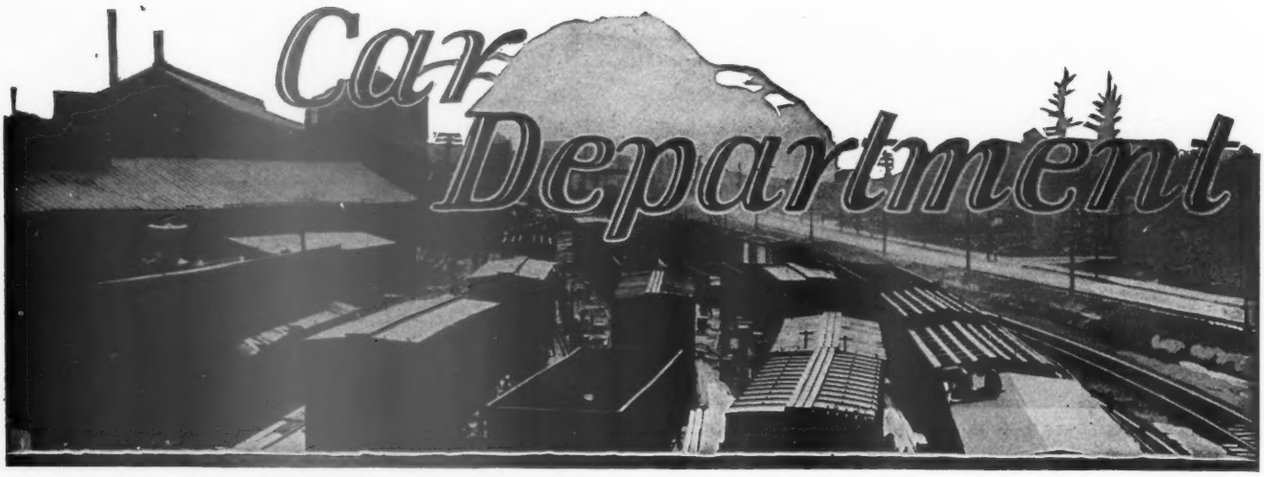
A hopper car of the 'Forties



An iron box car of the 'Forties



The "William Galloway"—1837



Equipment painting section meets at Louisville

Reports indicate increasing use of lacquer—Mechanical passenger car washing a new factor in maintenance of finish

THE three-day session of the Equipment Painting Section, Mechanical Division American Railway Association was held at the Hotel Kentucky, Louisville, Ky., September 13, 14 and 15, 1927. At this meeting, which was the sixth annual meeting of the Section and the fifty-seventh anniversary of the organization of the former Master Car and Locomotive Painters' Association, there was registered a total of 143 railroad men representing 64 different roads. The total registration, including guests of the members and railway supply representatives, was approximately 400.

During the three-day session three individual papers were presented in addition to six committee reports. The papers were: Fifty years in a railway paint shop, by W. O. Quest, past president, 1892; Rust, by D. Warner, foreman painter, Canadian Pacific, and Relations between master painter and chemist on railroads, by B. E. Miller, master painter, Delaware, Lackawanna & Western. The committee reports were as follows: Tests, Standards—car and locomotive, Shop, construction and equipment, Maintenance and care of paint and varnish at terminals, New developments in equipment painting with economies involved, and Ornamentation of cars and locomotives.

James Gratton (B. R. & P.)
Chairman

F. E. Long (C. B. & Q.)
First vice-chairman

L. B. Jensen (C. M. & St. P.)
Second vice-chairman

Mr. Quest, in reviewing 50 years of railroad paint shop work told of the period after the Civil War when there was a great deal of competition between the individual roads in the matter of decoration of passenger cars and locomotives. The interiors of passenger cars were elaborately finished in costly woods and were expensively hard

varnished and hand polished. Locomotives were resplendent with polished brass fittings, and driving wheels and trucks were striped in colors and gold designs which, in many instances, required the use of from 90 to 100 books of gold leaf in order to decorate a single locomotive. After the financial panic of 1873 there was a drastic retrenchment in the matter of maintaining equipment, with the result that the decorations were the first to go. In the matter of shop work Mr. Quest reviewed the materials and methods in use years ago and brought out the fact that it then required from 35 to 60 days for the original finishing or burning off and repainting of a first-class passenger locomotive.

Election of officers

The following officers were elected to serve for the year 1928: Chairman, L. B. Jensen, general foreman, passenger car department, Chicago, Milwaukee & St. Paul, Milwaukee, Wis.; first vice-chairman, H. C. Allehoff, foreman painter, Oregon-Washington Railroad and Navigation Company, Portland, Ore., and second vice-chairman, D. C. Sherwood, foreman painter, New York Central, West Albany, N. Y.

The following members were elected to serve on the committee of direction during the coming year: Marceau Thierry, foreman painter, Norfolk & Western, Roanoke, Va.; B. E. Miller, master painter, Delaware, Lackawanna & Western, Kingsland, N. J.; J. W. Gibbons, general foreman, passenger car department, Atchison, Topeka & Santa Fe, Topeka, Kan.; F. B. Davenport, foreman painter, Pennsylvania, Columbus, Ohio; H. Hengeveld, master painter, Atlantic Coast Line, Waycross, Ga.; K. J. Johnson, foreman painter, Nashville, Chattanooga & St. Louis, Nashville, Tenn.; in addition A. E. Green (C. & N. W.), a past chairman, will serve on the committee, and J. Gratton the retiring Section chairman will act as chairman of the committee of direction. The association voted to hold next year's convention at Montreal.

Report on shop construction and equipment

It is presumed by the Committee that if any Class I railroad were to build an up-to-date paint shop it would be somewhat different in construction than most shops are today. To meet the requirements of outside sources, namely, fire insurance and health authorities, and also retain the experienced help necessary to take care of other work which cannot be done with the spray gun, we would suggest that in order to carry out these new changes in shops now equipped for hand brush work only, presuming that there are two or three cars on a track, that three or four tracks could be partitioned off with galvanized iron with the necessary ventilation to take care of the fumes and with two electric fans situated near where the car is being sprayed, which will help to take care of the vapor to some extent.

In the construction of a new up-to-date paint shop to take care of the new methods of finishing passenger car equipment the quantity of car output would to some extent determine the size of the shop and the number of cars on a track. The shop should be equipped with permanent staging to be let down with the man on the staging and go up by pushing it when the man is standing on the floor. The shop should be equipped with the best heating system possible in order to carry an even temperature of about 70 deg. during cold or damp weather. High skylights in the top of the shop roof should be between the tracks in order to throw all light possible on sides of cars. The top half of all track doors should be glass. Large windows should be on each end of a shop. Skylights in the roof should have three or four ventilators which could be opened or closed from the floor, also two ventilators on each side of the shop equipped with suction fans to take care of lacquer or paint fumes when spraying. There should be a large ventilator with a slide situated on each side of the shop near the floor to furnish fresh air when necessary. Light, heat and ventilation are very essential for good work.

There should be fire walls between the main shop and the varnish room, also between the shop and wash tracks. The varnish room should be at the end of the main shop and furnished with sash and window racks and door racks.

The stock room is to be located at the end of the varnish room with a serving window in the main shop and also the varnish room. The outside door leading to the main stock room should be where all material is delivered in car-load lots that can be taken into the stock room as needed.

The varnish room at the end of the building should be of two-story construction; on the first floor the lacquer and varnish room and on the second floor the upholstery room with a freight elevator at one end for carrying cushions and backs to the upholstery room. Lavatories should be between the first and second floor with steps leading up to them and continuing to the upholstery room on the second floor. Dressing room should be placed on the first floor underneath the lavatories.

The outer or main stock room should be a small brick building at least two or three hundred feet from the paint shop with high platforms on each side, the height of a freight car door for unloading all heavy barrel material. This stock room should be furnished with tanks in the cellar, with pumps operated from the floor above. This is where oils, turpentines, etc., could be kept and pumped up as needed. Also, a motor for mixing and breaking up white lead should be part of the equipment.

A sand blasting shed is necessary to a paint shop and should be located not less than 300 ft. away, as practically all railroads are going in for steel car equipment and thus sandblasting is becoming more necessary every year.

The mill and cabinet room, also the carpenter and steel shop should be adjacent to the paint shop, located so that the transfer table should run between the paint shop and carpenter and steel shops with trackage room enough between the shop and transfer table for storing one car outside each shop. Cars after being transferred from the coach shop to the paint tracks could then have trucks, steps, platforms, and running gear sprayed before entering the paint shop.

Appendix—Varnish room equipment

In the first place, the varnish room should be of the size to take care of all work in rush seasons without crowding, and should be light, well ventilated, and heated sufficiently to take care of the proper drying of the work.

Next to having a large, light, well ventilated and sufficiently heated varnish room, is cleanliness. Next to cleanliness, let us consider the equipment. By this we mean, first, the work tables and jacks on which the men work when painting or varnishing car body sash and other small work. These should be individual tables of suitable size, the tops of which should be covered with some suitable metal, easy to clean.

Suitable drying racks mounted on wheels, which can be pulled up to the workman's bench, to take care of

car body sash or deck sash, are suggested. By the use of these racks, increased production and better work is assured. Another advantage which this kind of a rack has, is where a spray booth is employed. The operator pulls the rack up close to the booth and deposits his work in the rack without much trouble, and when filled he proceeds as has been explained above, thus eliminating the need of a helper.

Another valuable piece of equipment in connection with the varnish room is to have a suitable place to stack doors during drying periods, or for final storage before they go to the trimmers. For this reason we suggest a regular door rack, built in some convenient place, within the varnish room, where the doors can be removed, when needed, without disturbing other work.

The rubbing room should be adjacent to the varnish room, and provided with proper rubbing tables, something similar to the ones used in the varnish room, except that the metal on top should be left off. Also in the rubbing room there should be a wash tank for thoroughly cleaning off the pumice stone after the work has been rubbed. This tank should be built of wood and lined inside with sheet copper. The size of this tank should be determined by the amount of space available or by the work to be handled.

The report was signed by: J. T. MacLean, chairman, B. & M.; O. S. Minnick, W. M.; C. E. Ream, Penna.; W. F. James, A. C. L.; D. Richmond, Pullman Car & Mfg. Co.; F. Clement, American Car & Foundries Co. and W. M. Joyce, Baldwin Locomotive Works.

Discussion

In the report of Shop Construction and Equipment cognizance was taken of the fact that the increasing use of lacquer has brought about the requirement of somewhat different shop facilities. In the discussion of this report the question was raised as to whether or not the actual fire hazard, about which there has been much comment, attendant upon the use of lacquer is actually as serious as at first seemed possible. One member ventured the inquiry as to whether or not those in attendance had personal knowledge of any fire or explosion that might be directly attributed to the use of lacquer. Aside from a serious explosion that recently occurred in an automobile body plant none of the members seemed to have come in contact with any accidents in railroad shops regardless of the fact that lacquer is now quite widely used—in the case of one road the greater part of its passenger equipment being finished with this material. The consensus of opinion seemed to be that the prime requisite in the use of lacquer is for ordinary care and absolute cleanliness about the shop. Also that if the same precautions are taken as in the use of other finishing materials or in the use of varnish remover there need be no concern as to the fire hazard.

Standards—Car and locomotive

Your committee, after careful consideration, feels that it is entirely impractical to establish definite painting standards. It has, therefore, in this report, considered itself more of a committee of equipment painting practices. It will be noted that in the report the recommendations are general and follow the above line.

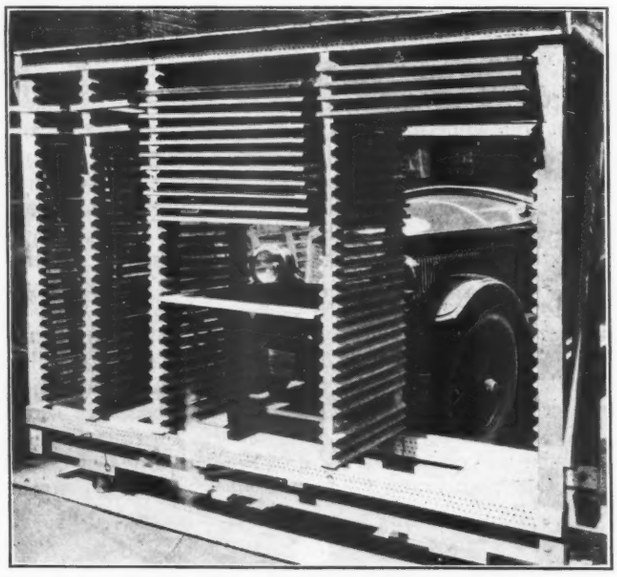
Schedule of short system of passenger equipment painting

Owing to the fact that the majority of railroad companies are looking for a method of painting their passenger equipment more for protection than for beauty, and that the lacquer system is still being experimented with, we are presenting to you, at this time, a short and durable schedule of painting.

It is well known that every day a car is held out of service it loses money, and we know of steel cars that have been in service for over two years with a coat of primer, one coat of body color, semi-gloss, and two coats of wearing varnish. While we do not recommend this as a regular practice, we do recommend the following schedule:

EXTERIOR BODY

First day—Sand blast and prime with railroad company's standard steel car primer.
Second day—Stand to dry.
Third day—Coat of surfacer (surfacer to be the same shade or near the same shade as body color which is to be applied).
Fourth day—Putty and knife-in where necessary.
Fifth day—Sandpaper dry or sandpaper to a smooth surface with wet or dry sandpaper and water.
Sixth day—Apply one coat of heavy-bodied, semi-gloss body



Portable sectional drying rack suitable for different size window sashes

color. If shade of color is such that two coats would be necessary to cover solid, one coat of body color ground in Japan and thinned to brushing consistency with pure turpentine can be applied before the semi-gloss on the sixth day.
Seventh day—Letter and stripe.
Eighth day—First coat of varnish.
Ninth day—Stand to dry.
Tenth day—Second coat of varnish.

INTERIOR BODY

First day—Sand blast and prime with railroad company's standard steel primer.
Second day—Stand to dry.
Third day—Coat of surfacer, if car is to be grained, surfacer should be same shade or nearly same shade as ground color.
Fourth day—Putty and knife where necessary.
Fifth day—Sandpaper and apply a coat of ground color for graining.
Sixth day—Sandpaper lightly and grain.
Seventh day—Apply a coat of varnish.
Eighth day—Letter and ornament.
Ninth day—Coat of varnish.
Tenth day—Stand to dry.
Eleventh day—Coat of varnish.
Twelfth day—Stand to dry.
Thirteenth day—Rub with pumice stone in oil or water, in accordance with railroad company's practice.

If enamel is to be used on the interior instead of graining system, it may be applied on the fifth day, second coat on the seventh day and lettering and ornamenting on the eighth day.

All exterior sash and doors should receive the same treatment as the body of the car.

Roof and deck—steel—If necessary to sand blast, prime with

basic chromate of lead followed with two coats of railroad company's standard roof paint or one coat of primer and one coat of heavy car cement.

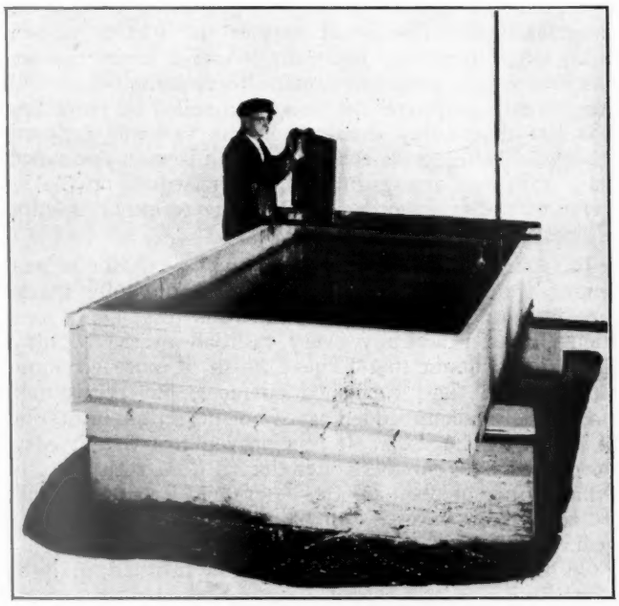
Trap door and steps—If sand blasted, prime with basic chromate of lead, coat with two coats of enamel, or finish the same as body of the car.

Trucks and underneath work—All underneath work should be coated with a good metal protector paint or car cement; trucks—two coats of paint in accordance with railroad company's standard.

Painting locomotives

A practical and economical method of painting all types and classes of locomotives by brush or spraying machines is as follows:

On a locomotive that is badly checked and cracked and the finish deteriorated to the extent that it has become short and brittle, also on newly built locomotives,



Tank in rubbing room in which pumice is washed from pieces to be varnished

your committee recommends that all old paint, rust, scale and grease be thoroughly removed from metal, preferably by sand blasting. When thoroughly cleaned, prime with a coat of metal protector primer. Putty and glaze where necessary and apply one coat of surfacer.

As all steel is more or less pitted, your committee recommends that the foreman painter be the judge of the number of coats of surfacer needed to build up as smooth a surface as may be desired and in severe cases would recommend that a knifing coat be used.

Sand paper and apply one coat of locomotive black finish. Letter and stripe in accordance with railroad company's standard. Varnish with a coat of locomotive finishing varnish (two coats on passenger and one coat on freight locomotives).

The locomotive black finish and finishing varnish should be resistant to both hot and cold water.

On locomotives that have a good body, being free from checks, etc., but on which the finish has become dull in appearance, when in the shops for general repairs, your committee recommends the following: All grease and grit should be thoroughly removed by washing with suitable solvent that will cut the grease and is not injurious to the finish. Sand paper and touch up with primer; putty abrasions where necessary; sandpaper and apply one coat of locomotive black finish; letter, stripe and varnish in accordance with class.

The report was signed by: D. C. Sherwood, (chairman), foreman painter, New York Central; G. H. Lehnen, foreman painter, Chicago & Eastern Illinois; A. E. Green, foreman painter, Chicago & North Western; J. N. Voerge, general master painter, Canadian Pacific; K. J. Johnson, foreman painter, Nashville, Chattanooga & St. Louis, and G. F. Dennee, foreman painter, New York, Chicago & St. Louis.

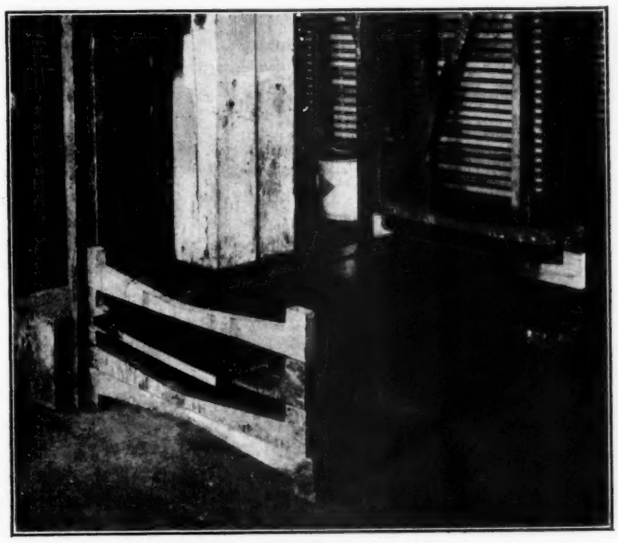
Discussion

A great part of the discussion in connection with this report concerned minor details of the wording of the report itself to which members took exception. Such points as were agreed upon and changed are shown corrected in the abstract above.

One point was raised, however, concerning the painting of new galvanized iron car roofs (not included in the abstract). The report indicated that a coat of paint should be applied to new galvanized roofs, for appearance's sake only. One member, assuming that the report could be interpreted to mean that no paint is necessary where the metal is protected by galvanizing, objected to leaving such roofs bare. The discussion brought out the fact that there is a real necessity for paint protection on the inside of galvanized roof sheets against which surface moisture has a detrimental effect. Subsequent protection of the outside surface may be accomplished by sand blasting and painting.

Maintenance and care of paint and varnish at terminals

This year's report of this committee covered in detail the recommended practice in connection with the interior and exterior cleaning of passenger cars and the terminal painting of passenger cars and locomotives. Of



Arrangement of sectional drying rack for doors

more timely interest, however, was a supplementary report concerning the use of a mechanical car washing machine of which the following is an abstract:

The passenger car washing machine as built, installed and used by the Baltimore & Ohio in the coach yard at Pittsburgh, Pa., was put into operation on June 13 and up to August 18, 67 days, it had washed 3,501 cars, a daily average of a little over 52 cars, working only 8 hrs. per day. It has washed 104 cars in one 8-hr. day.

They used only four men, 2 men on each side to apply

a weak solution of oxalic acid, with a long handled brush, on the window glass before the cars pass through the spray; two men, one on each side to operate the water sprays and brushes.

The method used is as follows: While the switch engine is pulling the train through at the rate of about two m.p.h., the acid is first applied to the glass only, then the first spray wets the car after which it passes through the brushes and then through the other spray to rinse off.

The brushes are of fibre about four in. protruding from the core, three in number on each side, and are set in a staggered position so as to overlap each other. The whole equipment is so designed that as the car passes between the two sets of brushes, each brush will be forced against the car with just enough pressure to give the right brushing effect on the particular part of the surface which it is intended to cover.

The cars are not wiped off, the water being allowed to evaporate. The ends of the cars and vestibules are washed by hand. The cars will dry off in less than one hour.

Each car is passed through and washed in two min. and one six-car train passed through in 9½ min.; another seven-car train in 14 min. requiring only four men to wash the sides; 56 minutes or less than one man-hour, that formerly required 35 man-hours for the same number of cars.

The railroad has taken off six men, thereby saving over $600 monthly, the cars have a better appearance and there is nothing left on them to collect dust. No additional switching is required as the trains are washed as the engine pulls them from the station to place them in the storage track where the interiors of the cars are cleaned.

The installation at Pittsburgh cost about $2,000 with a monthly saving of over $600, or a cost of only between 40 and 50 cents per car to clean. The mechanical washing is more thorough and gives a much better appearance than hand washing, regardless of the condition of the car before being washed.

A great advantage of the method is the number of cars that can be quickly cleaned between "rush" periods during excursion times. It enables the entire equipment to be handled more often than by the old method thus presenting a better appearance day by day, and with this operation, after the car is ready for service it will be found that the appearance is better than could have been the case when cleaned by any hand operation and without streaking or smearing. In washing cars by hand it generally happens that the appearance seems fairly good as soon as the water has been put onto the surface with the result that the operator does not give the necessary scrubbing or washing effect, and streaks and smears are observed as soon as the surface is dry. These streaks and smears can then be removed.

The supplementary report was signed by K. J. Johnson, foreman painter, Nashville, Chattanooga and St. Louis, as a sub-committee.

Discussion

In the discussion of the supplementary report the question was raised as to whether or not the action of the fiber brushes embodied in this machine had any detrimental effect on the exterior finish of passenger cars. One of the members who had investigated this matter reported that while the washing machine had been in operation only a short time there did not appear to be anything about its use that could result in harm to the finish of the cars.

New developments in equipment painting

The report of the committee this year consisted of answers to seven questions that had been asked of the committee by railroad officers. Two of these questions seem to be of particular interest and the replies are abstracted as follows:

Question No. 1—Brushing, dipping and spraying lacquers. Use and availability for various parts of railroad equipment.

In the opinion of your committee there is a field for dipping lacquer for parts such as package racks, hat hooks, door locks, and other small removable parts that heretofore have been painted and required an oven to accelerate the drying in order to get them through the shop on time. The brush lacquer for foot rests, seat ends, etc., fills a long felt want. Almost every railroad has in the past paid for damage to clothing, shoes and other wearing apparel that has been soiled by paint that was not thoroughly dried when the car was put into service. Owing to the ease with which lacquer is cleaned, many railroads are testing out brush lacquer on the interior of toilets, in order to eliminate terminal painting of these parts.

In regard to the use of lacquer on the exterior of passenger train cars, your committee respectfully marks time, awaiting the result of numerous tests being conducted upon practically every railroad in the country. There is no doubt that lacquer finish is more economically cleaned than varnished surfaces, but the system most widely recommended saves but little time in getting a car out of the shop. It is a proved fact that it costs more to finish a car in lacquer than it does with varnish. On a lacquer finished car the letters and figures are only protected with varnish pencilled on, and owing to this weakness it costs more to maintain the letters.

On the interior of passenger cars finished in light colors lacquers are almost essential to the economical maintenance of equipment. The committee has had experience in terminal cleaning of cars finished in varnish and find that the constant washing erodes the varnish and paint in a comparatively short time, making it necessary to maintain an extra force of painters and cleaners at terminals. Therefore, your committee states that there is a field for brushing, dipping and spraying lacquer, but discrimination should be used as to where it is applied.

Question No. 7.—Is there a successful and economical substitute for sand used in connection with sand blasting operations on cars and locomotives?

Owing to the excessive amount of dust created when sand is used to remove paint, rust and scale from railway equipment preparatory to painting, and the apparent impossibility of getting sufficient suction to carry this dust away from the operator, a number of shops have been testing metal abrasives as a substitute for sand. Your committee has investigated this process and respectfully report that these abrasives do very satisfactory work with a minimum amount of dust. The cost of operation will vary according to the efficiency of the blasting machine and the device for handling the abrasives, also the cost of the metal abrasives.

Some shops seem to be reluctant to give information that would aid your committee to arrive at the cost of operation. There was, however, one outstanding exception, and we are indebted to an eastern railroad for the information that follows.

Cost of metal abrasives

Price per ton of abrasives formerly used	$80.00
Price per ton of abrasives proposed	55.00

It is figured that ten tons of the $80 per ton abrasives will clean 56,286 sq. ft. of surface. Cost of material per sq. ft. cleaned is 1.43 cents. If the cheaper grade of abrasives proves as efficient as the other the cost of material per sq. ft. cleaned will be approximately 9 mills.

The cost of air used at a pressure of 100 lb. through a nozzle with a ¼-in. orifice will be 25 cents per hr.; ⅜-in. orifice 60 cents per hr.; ½-in. orifice $1.03 per hr. Therefore, the kind and size of nozzle used will greatly affect the cost of the finished product.

The writer, after extensive tests in cleaning metal with sand ejected through various size nozzles, in a report made in 1919, said that the nozzle should not have an orifice of less than ¼ in. or more than ⅜ in. to secure the most satisfactory and economical results, and we believe that this rule will hold good when metal abrasives are used instead of sand. In fact, owing to the high cost of metal abrasives, the efficiency of the nozzles of the size quoted above would be clearly demonstrated.

Total time for performing the operations required to clean a 70-ft. coach on interior and exterior is as follows:

Preparing car	3 hours
Blasting paint off	56 hours
Clean out and blow off dust	12 hours
Total labor	71 hours
Estimated time nozzle ⅜-in. orifice was in use	56 hours
Total number sq. ft. cleaned	3,421
Total cost estimated for air	$33.60
Total cost of air per sq. ft. cleaned	.0098 cents
Total cost of metal abrasives per sq. ft. cleaned	.0143 cents
Total cost of labor per sq. ft. cleaned	.011 cents
Total cost of labor and material per sq. ft. cleaned	.0351 cents
Total cost labor and material 3,421 sq. ft.	$120.08

If the metal abrasives that are offered for $55 a ton are as efficient as the grade formerly in use this would reduce the cost per sq. ft. cleaned approximately one-half cent, and the total to $74.26.

It is evident from the above report that if it were possible to get a sand blast plant that would remove the dust from the operating room and handle the sand economically, the use of sand would be the best and cheapest method of removing paint from a metal surface, but owing to the fact that the ordinary sand in use in most parts of the country is full of dust the whole question resolves itself into either securing sufficient suction to carry out the dust, or go to the use of metal abrasives.

In view of the above fact, your Committee is unanimous in answering "Yes" to question No. 7.

The report was signed by: J. W. Gibbons (chairman), general foreman, passenger department, Atchison, Topeka & Santa Fe; B. E. Miller, master painter, Delaware, Lackawanna & Western; C. W. Carter, master painter, St. Louis-San Francisco; B. F. Fultz, foreman painter, New York Central (Ohio Central Lines), and G. S. Corson, foreman painter, New York Central.

Decisions of the Arbitration Committee

(The Arbitration Committee of the A.R.A. Mechanical Division is called upon to render decisions on a large number of questions and controversies which are submitted from time to time. As these matters are of interest not only to railroad officers but also to car inspectors and others, the Railway Mechanical Engineer will print abstracts of decisions as rendered.)

Rule 32

In May, 1925, the Oregon-Washington Railroad & Navigation Company made repairs to Vicksburg, Shreveport & Pacific box car No. 25624, for which a bill was rendered to the amount of $253.66. The bill was passed by the V. S. & P. for payment in June, 1925, and a request for authority for recharge of this amount recovering the same rendered against the O. W. R. R. & N. which was declined. The handling line claimed that the car was damaged while in a train being pulled up a 1.8 per cent grade by two locomotives, and that the damage was due to decayed wood sills. The owner took the position that the handling line had not furnished sufficient statements showing how the damage occurred as required by interpretation No. 3 to Rule No. 43 in Supplement No. 1, and cited arbitration case No. 1283 as a similar situation.

The Arbitration Committee held the handling line responsible, pointing out that Decision 1283 was parallel. —*Case No.* 1473, *Oregon-Washington Railroad & Navigation Company vs. Vicksburg, Shreveport & Pacific.*

Credit for undamaged parts of draft gear removed

On August 27, 1924, the Chicago & North Western repaired St. Louis-San Francisco car No. 128143, at which time they removed a Westinghouse D-4 draft gear on account of a broken spring and applied a Miner A-2-S draft gear there being no Westinghouse draft gear repair parts in stock. The repairing line allowed scrap credit only, for the complete draft gear removed, maintaining that the rules in effect at the time did not provide any arbitrary credit for undamaged parts of defective friction draft gears removed, the intent of the rules being that defective friction draft gears as a whole were to be credited on the same basis as undamaged non-A. R. A. standard parts removed under the provisions of Sec. A, Rule No. 17.

The owner maintained that the case should be settled under the principle involved in Rule 101, Supplement No. 2, which became effective August 1, 1925, as it was not fair to the owner to scrap a complete draft gear when only one part is broken.

The Arbitration Committee stated that "undamaged parts of draft gear removed by the Chicago & North Western must be credited at value new, in accordance with the rules in effect at the date of repairs."—*Case No.* 1474, *Chicago & North Western vs. St. Louis-San Francisco.*

Application of interpretation to unsettled cases

During the latter half of 1924 the Baltimore & Ohio repaired five Chicago, Burlington & Quincy cars for which the B. & O. rendered a bill to the owner. New wheels were applied to the cars on axles having wheel seats in excess of the length prescribed by the A. R. A. code of rules for the Manual of Standard and Recommended Practice. The charges in the bill were on the basis of new wheels applied less credit allowed by the existing rules. The C. B. & Q. claimed that the charges should not have exceeded those for second hand wheels where the axle seats did not exceed the ⅛-in. tolerance and for scrap wheels where the seats exceed ⅛ in. over the maximum dimensions in accordance with the intent of Arbitration Case 1333 and the interpretations furnished clarifying this decision which was subsequently embodied in Supplement No. 1 to the 1924 Code as Nos. 9 and 10 to Rule 98. The B. & O. contended that the charges were correct and that the intent in question did not apply to cases originating prior to the 1924 code, in which paragraph (f) of Rule 86 first appeared. There was no disposition on the part of the B. & O. to question the dimensions or facts in question but to adjust the claims on the basis of the dates of repairs.

The Arbitration Committee stated that, "in view of

the principles of decision 1333, interpretations 9 and 10 of Rule 98 as per Supplement No. 1, dated May 1, 1925, are retroactive in application in these unsettled cases.—*Case No.* 1475—*Baltimore & Ohio vs. Chicago, Burlington & Quincy.*

Repairing fair and unfair usage items at the same time

On March 11, 1925, the Chicago & North Western repaired Archer-Daniels-Midlands car No. 810 which had been cornered in switching service and the following items were marked "no charge" on the face of the billing repair card:

End running board	A	Cornered
Grab Iron	A	
Side running board	A	
End running board	B	

At the same time the C. & N. W. applied a Type D coupler, B end, on account of removing a Sharon coupler with a broken head. The coupler pocket was also repaired on account of being bent. The C. & N. W. claimed that the coupler repairs were made on account of owner's defects, whereas, the owner contended that the damage to the coupler was done at the time that the car was cornered in switching service and that no bill should be rendered except for the difference in value between the old standard and Type D coupler and stencilling the car for this change. The C. & N. W. contended that the slight damage which actually occurred to the wood running boards was not of such a nature as to have caused any damage to the coupler and the pocket and that, therefore, these items were billed against the owner in accordance with Rule 41.

The car owner was held responsible for the damaged coupler and coupler pocket in accordance with the provision of Rule 41.—*Case No.* 1476—*Archer-Daniels-Midlands Company vs. Chicago & North Western.*

Billing on authority of defect cards

On December 24, 1923, the Mid-Continent Tank car No. 593 was damaged in an accident on the Chicago, Rock Island & Pacific. The car was moved to the owners' shops for repairs where a joint inspection was held and the results forwarded to the Rock Island which issued a defect card under the date of March 7, 1924. The owner made repairs and presented a bill. After the repairs were completed, the owner advised that a change in management had taken place and that the present management was basing its contentions on the information shown in the records of the company left by the old management under which the repairs had been made and rendered the invoice for the repairs on this car. A representative of the Rock Island and the present management of the owner held a conference to arrive at a settlement on the car during which the bill was reduced $18.68, which amount covered exceptions on excessive weights and number and size of bolts and rivets. The two parties, however, failed to reach an agreement on items covered by the actual time for labor not specified in the A. R. A. Rules, such as painting the car, charges for distillate, repairs to the body bolster A & R ends, and whether or not the draft sills were bent at both ends. The Rock Island stated that the owner seemed to base its contention principally on the fact that its accounts had been audited and certified by certified public accountants to be correct. That such an audit would not disclose actual erroneous charges is shown by the fact that 14 erroneous charges were altered and eliminated from the original bill subsequent to the time accounts were certified as being correct. These errroneous charges were detected by actual inspection of the car which a certified accountant would not be in a position to develop by merely auditing accounts. Furthermore, the records of the owner were not maintained in accordance with the provisions of Supplementary Regulations effective January 1, 1924; for example, Form F or its equivalent was not used, but a form of the owners' own design. The form was filled out on a typewriter and additional information was filled in with a pencil and the report not signed, which, in itself, is a violation of the rules.

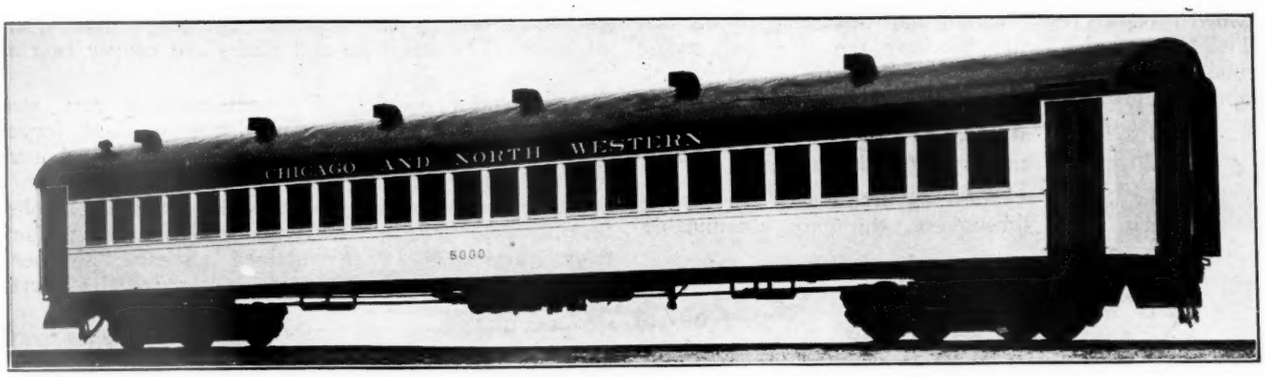
The Arbitration Committee rendered the following decision: "There should be no extra charge for distillate used in straightening bent parts. The charge for paint (material) should be confined to the painting of the parts covered by the defect card, including unavoidable damage caused in making repairs. The extra labor charge for painting should conform to Interpretation 8, Rule 107.

"The labor charges for repairs to tank heads, tank bottom sheet, calking of tank, and repairs to bolster and draft sills are excessive; however, the actual overcharges cannot be determined in view of the incorrect and incomplete original record of the repairs made. The adjustments proposed by the Chicago, Rock Island & Pacific are fair. The bill of the Mid-Continent Tank Car Company should be amended accordingly."—*Case No.* 1477—*Chicago, Rock Island & Pacific vs. Mid-Continent Tank Car Company.*

Tank for supplying fuel oil to rivet heaters

SHOWN in the illustration is a tank wagon used for delivering fuel oil to rivet heaters in the car shop. It has a capacity of 100 gal. A pipe connection is provided at the bottom to which a hose can be attached for loading and unloading. Fuel oil is forced into the tank from the storage tank at about 100 lb. pressure. Delivery from the tank to the rivet heater supply tank is secured by merely attaching the same hose to the tank on the rivet heater and operating the valve on the delivery tank wagon as the operator may desire.

Filling the delivery tank wagon at the storage tank

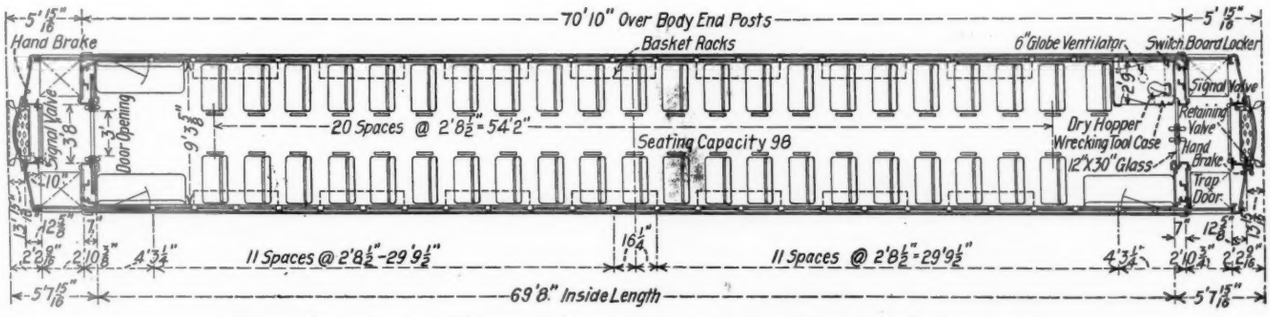


New Chicago & North Western suburban coach ready for service

Aluminum used extensively in new C. & N. W. suburban cars

Affords saving in weight of 5700 lb. per car—120 cars equipped with Melcher-Hyatt roller bearings

THE Chicago & North Western has recently placed in service 100 new suburban coaches and 20 combination passenger-baggage cars, notable for the extensive use of aluminum alloy plates in the construction of the car body and the application of Melcher-Hyatt roller bearings, one-third of this equipment having been built respectively by the Pullman Car & Manufacturing Corporation, the Standard Steel Car Company and the American Car & Foundry Company. The interiors are pleasingly finished in two shades of tan with cream color ceilings. There are 43 large comfortable two-passenger reversible seats with outside arm rests, and three four-passenger longitudinal seats. The backs and cushions, upholstered in green Massachusetts mohair plush, are easily removable for cleaning or repair. Parcel racks are provided. For emergencies and when passengers may be required to stand, all seats are fitted with handholds, and there are



Floor plan of new Chicago & North Western roller bearing suburban coach

The coaches, seating 98 passengers each or almost 50 per cent more than the old coaches, are attractive in appearance, comfortable, well lighted and ventilated. They are quick to accelerate owing to the use of roller bearings, and, while of the same center sill strength as cars in through main line passenger service, weigh but 98,300 lbs. light, or slightly over 1,000 lbs. per passenger owing to the extensive use of aluminum alloys in the construction. These last two features, namely, the roller bearings and light weight, have an important bearing on operation because more cars of this type can be handled by the same locomotives than formerly, or the same number of cars can be started and gotten up to speed in less time.

The exteriors of the cars are finished in the familiar North Western yellow and green colors, with brown metal straps over the longitudinal seats in the ends of the cars.

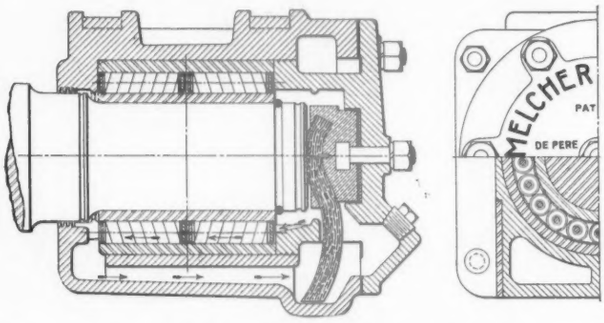
Twenty-six electric lights, staggered and placed directly over the seats, give excellent light for reading at night, and during the daytime 46 single brass sash windows, which are easily raised or lowered, permit the use of glazing wider and higher than when wooden frames are employed. From a maintenance standpoint these windows have the advantage that broken glass can be renewed without removing the sash from the frames.

The unusual standing space made available at each end of the car by the longitudinal seats will reduce crowding when a considerable number of passengers enter or leave the car at stations. Crowding will also tend to be avoided by the wide aisle, wide sliding, double-acting end doors and unusually wide steps

which promote rapid loading and unloading of the car. This construction will also have the effect of saving time at station stops. Full vestibule platforms furnish complete protection from the weather. A saloon is provided at one end of each car.

Fireproof construction throughout

The new North Western suburban cars are of all-metal construction throughout, the only inflammable



Cross section of Melcher-Hyatt passenger car roller journal bearing

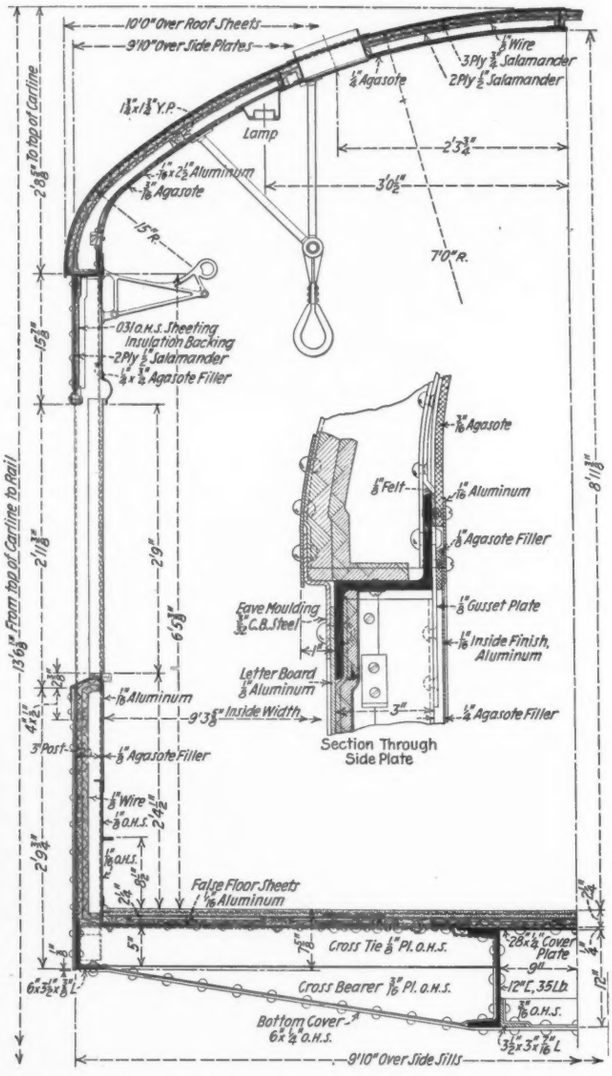
material used, being the wood caps on the seat ends and the window sills, thus making the cars absolutely fireproof. The frame work of the car is of steel with cast steel combination bolsters and end castings, fitted with heavy vertical end-reinforcing members, making it practically impossible for the cars to telescope in case of wreck. The fastenings of the trucks to the body of the car are so arranged that even in case of derailment trucks will not become separated from the car, thus providing an additional safety feature to prevent telescoping.

The principal members of the skeleton side frame, including the side sill, side posts, belt rail, corner posts,

The interior view of the suburban cars

side plate and their principal connections, are steel. The side posts are ⅛-in. copper bearing steel pressings. The underframe consists of a box girder center composed of two 12-in. 35-lb. channels reinforced at the bottom flanges with two 3½-in. by 3-in. by $\frac{7}{16}$-in. angles and a top cover plate 28 in. by ¼ in. Cross bearers, floor beams and body bolsters are of steel. The principal framing members of the vestibules and their connections, including the vestibule and posts, corner posts, end plate, ceiling plate and heat framing members, are of steel. The vestibule end plates are copper bearing steel.

The trucks consist of Commonwealth cast steel frames, bolsters and spring planks, with 33-in. forged steel and Simplex clasp brakes. Pullman type bolster locking center pins are used, also Wood's roller side bearings and American steel backed brake shoes. Roller bearings supplied by the Hyatt Roller Bearing Company, Newark, N. J., are contained in special "Melcher" type journal boxes developed jointly by the North



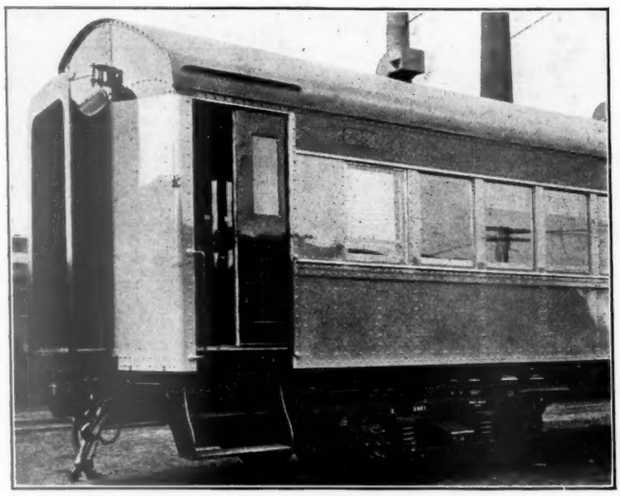
Half cross-section through car body showing application of aluminum sheets, method of insulation and other construction details

Western and the Railway Motors Corporation, De Pere, Wis. One important feature of this design is that the outside dimensions of the box are such that any pair of truck wheels can be removed at any time or place and replaced by standard A. R. A. wheels, journal boxes and brasses.

Use of aluminum saves 5,700 lb. per car

The light car weight of 98,300 lbs. is secured by the extensive use of aluminum alloy plates to form the roof, letter-board, side sheets, false floor, interior finish and doors. No more difficulty was experienced in working

and applying the aluminum than would have been the case with steel plates. The use of aluminum alloy for these parts saves approximately 5,700 lbs. per car, the alloy itself weighing 3,879 lbs. per car. A certain amount of car weight is also saved by using the elliptic or turtle back roof. The stereotyped form or curved



Close-up showing the car end and the truck construction with roller bearing journal boxes

hood was discarded in favor of a structure having roof framing members extending straight out to the vestibule face, it being felt that the resultant elimination of eccentric loads on the roof framing, due to impact, would provide a much stronger construction, weight for weight. The height of the car bodies is such as to provide vestibule side doors with sufficient clearance to permit future use of elevated station platforms.

Among the other important specialties used on these cars are Westinghouse schedule U. C. 1-16 brakes with U-12-B universal valve, Adams & Westlake basket racks, end door locks and hand brakes; Commonwealth body center plates and combined platform and body bolsters; American Brake Company slack adjusters; Waugh buffing devices, draft gears, coupler centering devices and hand straps; American Steel Foundries long shank passenger couplers; aluminum doors made by Pullman and the Morton Manufacturing Company; Morton vestibule step treads of the Kass type; Vapor system of car heating; Johns-Manville Masticoke laid on Acme Supply Company's Chanarch flooring, also on Pullman type metal flooring; lighting fixtures, switchboards and equipment furnished by the Safety Car Heating & Lighting Co.; seats made by Haywood-Wakefield, Hale-Kilburn and the Coach & Car Equipment Corporation; upper buffer springs furnished by the Union Metal Products Company; Utility ventilators, also Mudge Peerless ventilators; Rex vestibule diaphragms and Zapon curtains furnished by the Curtain Supply Company; vestibule trap doors, also window sash and fixtures furnished by the O. M. Edwards Company; curtains made of du Pont fabrikoid.

The insulation of this car received careful attention and consists, in the main, of two and three ply Salamander, either ½-in. or ¾-in. thick, applied as needed to the ceiling on the sides above and below the windows, inside of the side posts at the ends and on the floor.

The 20 combination passenger-baggage cars which are included in the equipment being built by the American Car & Foundry Company will be of similar design to the coaches except for a 20-ft. baggage compartment in the front end of each car.

Securing car shop efficiency

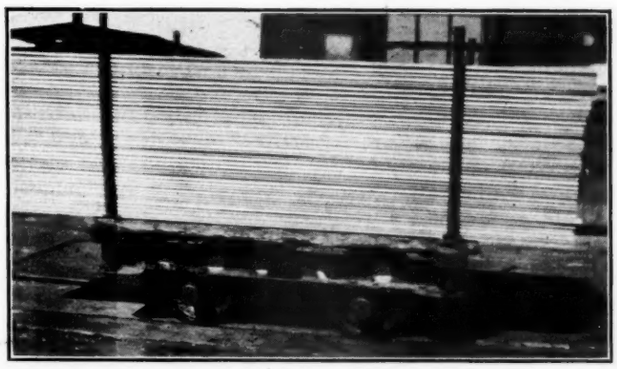
Paper read at Railway Car Department Officers' Convention credits straight line method and piece work as important aids

By E. G. Chenoweth

General car foreman, Chicago, Rock Island & Pacific, Blue Island, Ill.

IT is the object of every loyal superintendent of a shop to produce good results, and if the results are maximum under conditions encountered, high efficiency should be conceded. There is often no difference between a car entirely satisfactory for rough freight and one necessarily marked "bad order" for first class commodities. The policy of the railroad, with the judgment of the local supervisor, taking into account local conditions, determines what should be done, and to err in policy or judgment along this line is often expensive to the company.

In discussing shop operation, the outside influences cannot be left out of account. The railroad's business is the selling of transportation to the customer, and this is paramount, as equipment is of no value except as used for commercial transportation. If the demand of the customer changes quickly, is it not a fact that efficiency then can be measured by the speed with which the shop policy is changed to meet the requirements of transportation? The necessity of changing from one class of



Standard load of lumber ready for delivery to the cars

equipment to another as a shop preference at a moment's notice in order to meet the demands for a certain class of equipment is not unusual.

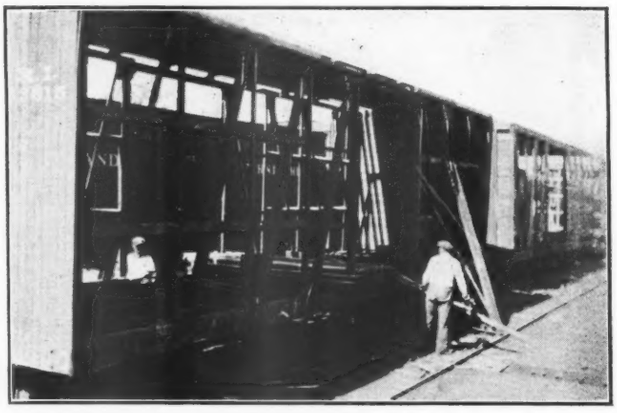
(Mr. Chenoweth here devoted some time to describing the straight line method of car repairs used at the Blue Island, Ill., shops of the Rock Island, a method not differing essentially from the modern "straight line" or "spot" system of car repairs now used at most up-to-date car repair points, and described at length in several articles in the *Railway Mechanical Engineer* during recent months.—Editor).

One of the problems which is encountered continually in some form or other is the question of material. The shortage of repair material will disrupt an organization quicker than any one other condition. In the shop where I am employed the number of items of material shortage was decreased one-half by submitting to the stores department each day a statement showing material not in stock but required, the material men reporting all shortages where found.

The procuring of material is, of course, ever essential, but the handling of this material after its arrival at shop is a study in itself, especially in a large shop. There must be a constant flow of castings, lumber, forgings, wheels, etc., from the storage to the consumer, and moreover, it must be delivered in advance of the time required. Trained material deliverers are essential to procure good efficiency. They should be kept in one class or on one kind of material where possible to do so, and not changed around. If material handling is paid for by the piece work system and the price made right, the better class of laborers will bid for the job. Keep the mechanics doing the repairs at the cars, putting on the material as much as possible, and let cheaper men bring the repair parts needed. However, I am of the opinion that in some cases it is profitable for a man carrying a mechanic's rate to deliver material. Less mistakes will be made and less detail supervision be required.

It was stated above that the man at the car should have the material delivered to him, and this material should be as nearly ready to apply as conditions will allow; steel fabricated ready to apply, and all sills, plates, carlines, posts and braces, etc., framed in mill, decking, siding, sub-roofing, etc., cut to length, before being delivered, by a swing saw which can be set up in a shed in the lumber yard for this purpose. A supply of this lumber cut to length should be kept in stock.

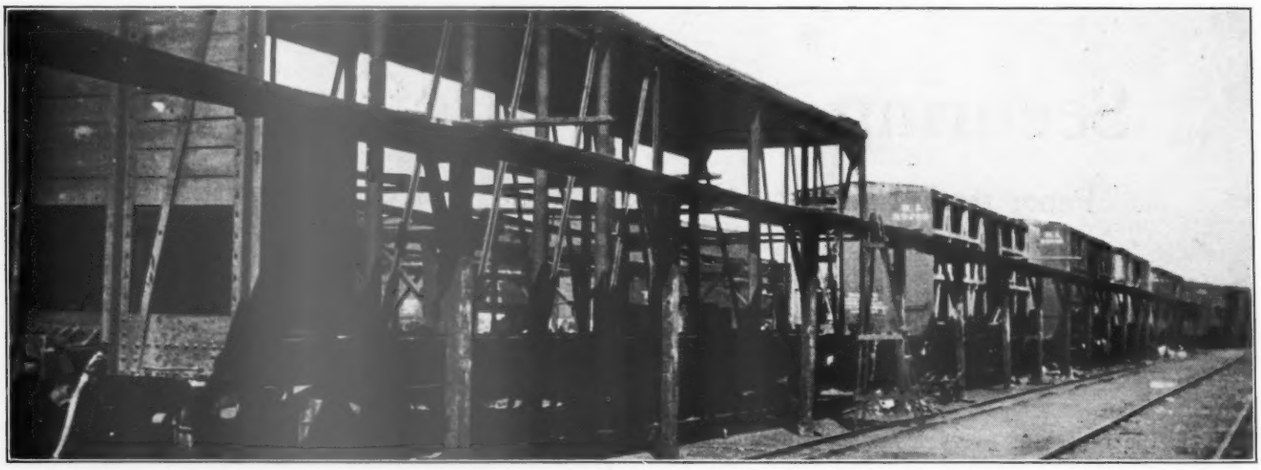
I want to emphasize the importance of properly organizing the forces which deliver material. Proper trucks should be provided and kept in repair for the handling of this material. Where cement or other good roads are installed, of course, the tractor with trailers are preferable, but many shops are still equipped with the industrial tracks with turntables or turnouts, and these are very good if properly installed to meet the shop requirements.



Reclaimed siding cleaned of nails and subsequently used for inside lining is piled in the car and checked by a piece work checker

Where trucks for different commodities are standardized, the checking of loads by the piece work checker is simplified.

At a large repair yard it is advantageous to have a bolt rack located in the yard and supplied with different sizes of bolts and other standard material; also brake beams and a few pieces of siding and decking in racks properly located.



Cars stripped for repairing—Standard scaffolds

Piece work decreases unit man hours

Any system of piece work employed in getting cars repaired decreases man hours required to perform a certain work because advantages are reaped by the workman in making special efforts. This method allows a man to earn according to his ability to accomplish results. A hustler is encouraged, and a loafer is discovered.

In a great many freight car shops throughout the country repairs are made in the open, and this was at one time considered satisfactory but today there is a

tendency in modern plants to construct buildings or sheds so that the weather conditions do not influence the output. While repairs can be handled in the open under bad weather conditions to a greater or less degree (generally less), painting and stenciling are held up. Therefore, the building of sheds for painting cars should first be considered in the modernizing of shop layouts.

The painting of equipment is essential and it is not advisable to wait for a general overhauling in order to paint. Light repair equipment should be painted as the condition of cars and shop conditions warrant. The spraying of paint is entirely satisfactory. A little brushing is necessary to take up any runs, and this is done from the ground using large brushes with long handles. The average time required to spray one coat on a car is approximately 45 minutes for the first coat and longer

Operation of paint spraying—Operator wears nose and mouth protector

for other coats as these require brushing. All stenciling can be done working piece work. It is advisable to have one man cut all stencils.

Stripping and cleaning on piece work schedule

The stripping of cars for repairs is done piece work and at a location other than where the repairs are made. This results in keeping debris from being scattered on repair tracks. For sheathing, saved and cleaned of nails when being removed, the strippers are allowed extra over the piece work price, and much lumber is saved in this manner which is used for inside lining, sub-roofing, etc.

To keep yards clean, I have found that the most effective plan is to do all of this work by piece work. It takes fewer laborers, and they naturally clean up the worst places first. While men are assigned in gangs of two to do this work, it is not an uncommon sight to see one man delivering truck side frames, bolsters or wheels to the place designated.

To afford increased efficiency there should be included electric welders, gas cutters, rivet busters and a well equipped tool room, furnished with a drill and reamer grinder so that the attendant can use all of his spare time in conditioning drills and reamers. He should also oil and make light repairs to pneumatic tools.

In the operation of any plant the safety and welfare of employees should not be overlooked. Personally I believe that being interested in the welfare of men brings good returns to the railroad.

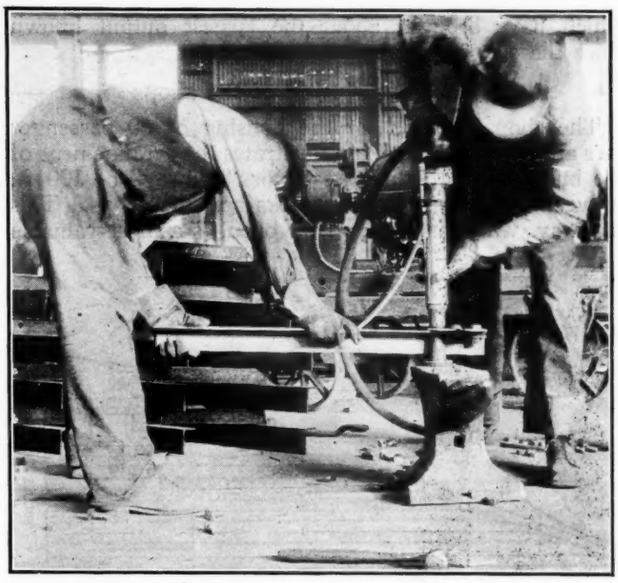
There are five items pertaining to shop operation, which appear to me to deserve careful study: material and handling, arrangement of yard tracks, some method of computing earnings based on work accomplished, organization and facilities, and efficient shop tools.

In closing, I am going to give you the result of a study made of the expenses in operating a large shop, the approximate pay roll being $50,000 per month with 400 men employed.

	Per cent of total rolls
Office	2.01
Planing mill	6.20
Blacksmith shop	4.38
W. H. Test rack man	0.41
Carman	44.59
Steel workers	18.54
Welders	2.54
Air brake men	1.22
Painters	2.04
Oilers	0.57
Tinners	0.95
Laborers	11.78
Miscellaneous, including power plant, foremen, checkers, etc.	9.79
Total	100.00

Riveting light material

IN rebuilding the steel portions of railway cars, it is often necessary to rivet re-inforcements on large quantities of light angles or other light material. This work may be accomplished easily and quickly in the manner shown in the illustration. An air gun tip is made to



A bucker block for riveting light material

fit in the top of a heavy anvil, or any other heavy block of steel. One man holds the light steel on top of the air gun tip while the riveter drives the rivets. As the pieces are completed, they are stacked in a rack nearby from which they may be easily picked up after the job is finished.

A general view of the N. Y., N. H. & H. passenger car repair shops located at Readville, Mass

New Haven passenger car repairs at Readville shops

Scheduling of material and work anticipated makes possible an output of 80 cars every 25 working days

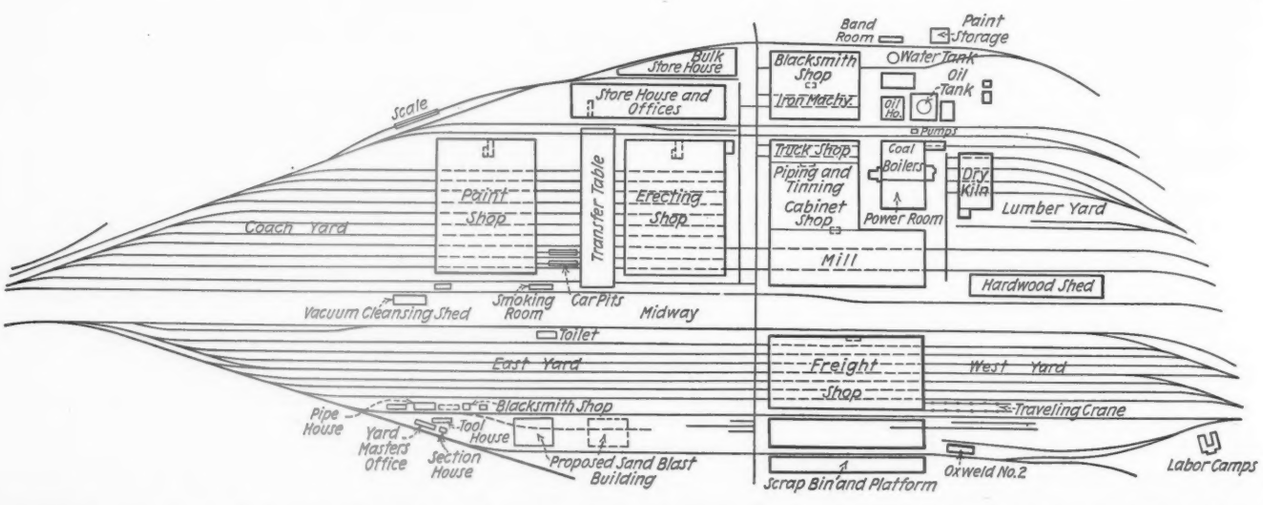
THE New York, New Haven & Hartford operates 2,125 passenger cars, part of which, approximately 88 per cent, are repaired at the large passenger car repair shop located at Readville, Mass., nine miles from Boston. With a force of 540 men, of which 426 are engaged in actual car repair work, an average of 40 steel cars and 40 wood cars are completely overhauled every 25 working days. Although the shops are not new, during the past three years complete changes have been made in the methods of repairing the cars, which have brought about the largest output known since the shops were built in 1901.

A brief description of the shops

The shops provide for the housing of 60 passenger cars at one time. The plan illustrates the arrangement of the buildings with the passage or "midway" of 100 ft. between the freight repair tracks and the shops. This roadway, which is always kept open, is a most valuable fire protection, fire precautions being well worked out. The buildings are as follows:

Paint shop	225 ft. by 300 ft.
Erecting shop	225 ft. by 300 ft.
Storehouse and offices	75 ft. by 350 ft.
Blacksmith shop	75 ft. by 200 ft.
Truck shop	50 ft. by 200 ft.
Piping, tin and buffing shop	50 ft. by 200 ft.
Cabinet shop	100 ft. by 200 ft.
Mill	125 ft. by 350 ft.
Freight shop	160 ft. by 350 ft.
Oil house	50 ft. by 50 ft.
Powerhouse	100 ft. by 150 ft.
Dry kiln	75 ft. by 125 ft.
Hardwood shed	50 ft. by 300 ft.

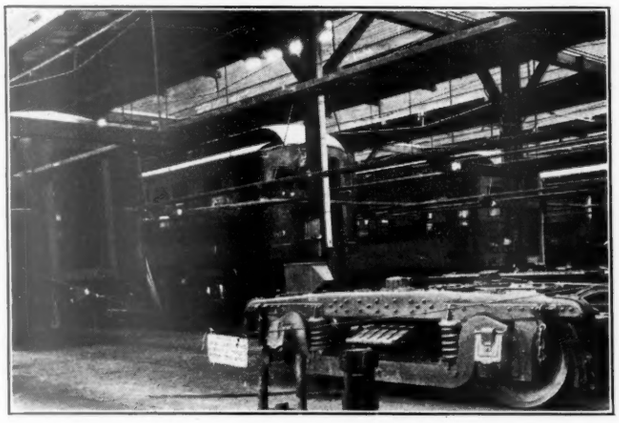
In each of the passenger car shops there are 10 tracks at 24 ft. centers, each holding three cars. The two shops are exactly alike, each with a second story in the south end for the varnish rooms, upholstery shop and toilet rooms. Between the paint shop and the transfer table, the tracks have a length of 100 ft. This space is used for storage and also permits of clearing the erecting shop promptly without waiting for cars to be removed from



General arrangement of the shop buildings and tracks of the New Haven passenger car shops located at Readville, Mass.

the paint shop tracks. The shops requiring machinery are placed together in a compact group, with a 100-ft. passage between them and the erecting shop and storehouse.

The lumber yard is west of the dry kiln and the mill, this part of the plan being laid out with a view to progressive movement of the material to and through the



A section of the steel car repair shop

mill. The whole plant, in fact, embodies the progressive movement idea throughout, as the plan indicates.

The arrangement of the buildings throughout is such as to save unnecessary handling of material. The oil house, machine shop, truck shops and storehouse are all served by two parallel tracks. All wheel work and heavy

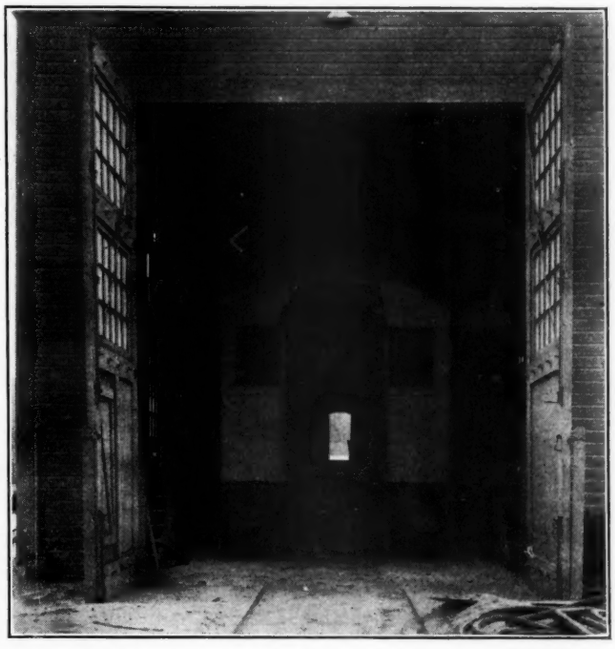
All truck repairs are made on this track

parts, and stores are conveniently handled here and the buildings used for light work are conveniently placed.

Passing a car through the shop

Every month, the passenger car shopping committee meets and plans a schedule of the cars to be repaired the following month. As a general rule the cars are shopped according to the length of time in service. Sufficient leeway is allowed in the schedule to take care of cars that may be damaged in an accident. The schedule is laid out on the basis of 22 days required to pass a car through the shop. The main object of the schedule is to bring the cars in the storage tracks just as they are needed, thus keeping them in service up to three days prior to shopping. It is part of the duties of the production supervisor to keep track of the cars scheduled for shopping and arrange to have them placed on the storage tracks at the proper time.

The cars are inspected two days prior to going in the shop. The inspection reports go to the material and production foreman who arranges for the necessary material and sets up the schedule for each car. The cars are stripped by the stripping gang of four men. They are then pushed into the cleaning shop which has a capacity for one steel and three wood cars, where the trucks are hand cleaned with a chemical which removes all grease and paint. When necessary, the inside varnish is removed and also the paint from those cars which have cop-



The steel cars are sand blasted in this new building

per covered sheathing. A force of 12 men is engaged in this work.

On the fourth day the cars are removed from the cleaning shop via the transfer table to a track located outside the north end of the erecting shop. Here the trucks are removed by four Whiting 15-ton hoists. Two shop trucks are temporarily placed under the cars. The trucks are then sent to the truck shop located in the erecting shop.

Formerly, the trucks were repaired at the stations where the cars were located. By repairing the trucks on one track, served by two Sheppard five-ton overhead hoists, it has been possible to increase the shop output. One end of the track is used for repairing trucks from wood cars and the other end for trucks from steel cars. All axle lighting generators are repaired on this track. The truck gang consists of seven men, exclusive of the electricians. After the trucks are repaired they are spray painted with a black mineral paint on two pit tracks. The former practice was to paint the trucks while under the car. It was found that the trucks were not properly painted which was conducive to corrosion. With the new method, every part of the truck is reached by the paint spray.

Coming back to the car again, it is next moved to the

sand blasting house which has a capacity for one car. This is a new building equipped with four Pangborn sand blasting machines. Two men can sand blast the outside of a car in 16 hours. The New Haven is now experimenting with sand blasting on the interior of the cars. If it can be used successfully, this method will supersede the present method of using a liquid paint remover.

On the sixth day the cars are lined up for the erecting shop and are spray painted with red lead. On the seventh day they are placed in the erecting shop where five days are allowed to make necessary repairs to the underframe and superstructure. The shop trucks are removed from the cars and they are placed on horses for the convenience of the workmen. It is well to note at this point that six days have elapsed since the car was inspected, which is ample time for all necessary material to be placed at the track on which the car is to be

The trucks are removed from the cars by four Whiting 15-ton hoists

repaired. The supervisor of production watches this matter carefully so that the schedule will not be disrupted owing to lack of material. The erecting shop will hold 12 steel cars and 18 wood cars.

At the present time from four to five baggage cars a month are being rebuilt with steel underframes. Ward ventilators are also being applied to all cars.

On the twelfth day the shop trucks are again placed under the car, after which it is moved to the track with the Whiting hoists where the trucks are applied. On the thirteenth day, the car is placed on a pit track where the underframe is sprayed with black mineral paint. The interior of the car is washed down preparatory to going to the paint shop. On the fourteenth day the car enters the paint shop where it remains for nine days. The cars are all hand painted. The copper-sheathed cars receive one coat of Sealox primer and one coat of copper enamel which completes the paint job. The interior trim is placed in the car, after which it receives its final inspection and is released to the transportation department for service.

Inspection system

A system of inspection has been set up whereby every item repaired must be approved before the car can be released for the next repair operation. The inspectors do not come under the jurisdiction of shop superintendent, but report directly to the assistant to the mechanical manager. With this arrangement the inspectors have the last word as to the correctness of the work. The foremen co-operate splendidly with the inspectors with the result that all work is correctly finished on time.

The increased output in the shop hinges largely on the schedule system, and the full co-operation between all departments. Every job is scheduled out on a certain day at a certain time. If, for example, a pair of trucks is scheduled to be completed at 10:30 a. m. on Tuesday and they are not ready, the matter is at once brought to the attention of the supervisor of production who investigates to determine the cause of the delay. The same system applies to the delivery of material. It is a rare occurrence when a car is not completed on schedule time and it is not unusual for a car to be completed one or two days ahead of schedule. It is believed that the present system will ultimately bring about a production of four cars per day.

Number of men employed in the different departments of the N. Y., N. H. & H. passenger car shops located at Readville, Mass.

No. of men	Work performed
	Steel erecting shop
31	Joiners, mechanics
14	Platform mechanics
	Wood erecting shop
28	Joiners, mechanics
14	Platform mechanics
12	Joiners, steel underframes for baggage cars
	Paint shop
47	Painters
14	Painter helpers
6	Apprentices
12	Car washers
	Mill shop
14	Mill hands
4	Helpers
	Stripping department
4	Strippers
1	Apprentice
	Buffing department
5	Buffers
1	Helper
	Upholstering department
14	Upholsterers
5	Helpers
1	Apprentice
	Cabinet shop
33	Cabinet makers
3	Apprentices
23	Trimmers
6	Helpers
2	Apprentices
	Tin shop
12	Tinners
2	Helpers
1	Apprentice
	Air brake shop
13	Fipe men
7	Helpers
1	Apprentice
	Electrical department
10	Electricians
3	Helpers
4	Apprentices
	Blacksmith shop
20	Blacksmiths
13	Helpers
	Machine shop
18	Machinists
12	Helpers
3	Apprentices
	Truck repairs
7	Repairmen
	Inspectors
3	General
1	Special duty

"A TRIP THROUGH ONE OF CLEVELAND'S LARGE INDUSTRIAL PLANTS."—This is the title of a bulletin issued by the McMyler-Interstate Company, Bedford, Ohio, in an endeavor to indicate, through illustrations, the extent of its plant operations and facilities. Illustrations also afford an index to the McMyler line of locomotive cranes, steam shovels, clam shell buckets, etc.

Discussion on car loading

Railway Car Department Officers' convention paper draws forth extensive comment

AT one of the regular sessions of the Railway Car Department Officers' Convention, held at the Hotel Sherman, Chicago, August 23, 24 and 25, as reported on page 593 of the September *Railway Mechanical Engineer,* W. J. Owen, chief joint inspector of the Peoria & Pekin Union, Peoria, Ill., read a paper on "Conditioning Cars for Loading." This paper was discussed at length, an abstract of the remarks of the various speakers being as follows:

T. J. O'Donnell (C. I. I., Buffalo, N. Y.): I would like to ask Mr. Owen in the survey situation if he considers it good policy to maintain special inspectors at large terminals to do this special inspecting for classification of cars for flour and grain loading. My experience has been that the best plan is to have special men to do this work.

Mr. Owen: No we do not have special inspectors.

T. S. Cheadle (R. F. & P.): The paper in my mind is as good as anyone could prepare, but it is my thought that if a car is not 100 per cent it needs a bad order tag. A car that is used for something that it is not intended for gets us into a lot of trouble. The best of judgment should be used by our inspectors in classifying cars.

M. P. Cole (B. & M.): I do not believe that a car unsuitable for a 100 per cent load should have a red tag. I will agree that there are many cars running today that should be in the shop for overhauling. All roads seem to handle just such cars.

We have classified the various cars as to the commodities which they are to carry. We cannot load cars stained with acid and grease spots, with paper or with china clay. The oil is sure to penetrate into the paper, therefore we have need for a clause in our rules stating that those cars which do not have an oil stain or acid stain to the extent of two feet square will be painted with a quick drying paint. I note Mr. Owens states that these cars should be washed. We have not found anything that will remove a stain by washing. I would like to have Mr. Owen tell us just what he thinks about the quick drying paint.

W. R. Rogers (C. I. I., Youngstown, Ohio): I would like to ask Mr. Owen what he does to have the operating department place the cars that he has selected. How does he manage to get the transportation department to place those cars?

Mr. Owen: We have no trouble along that line. It may be possible that the transportation and car departments are cooperating a little closer in our territory than in yours. Whenever we place a commodity card it is regarded by the transportation department. We apply these cards when the car first shows up in the terminal empty. Each empty box car in our territory carries two classification cards showing what it is fit to be loaded with, whether flour, grain or any other commodity. All the necessary information is furnished the superintendent, and yardmaster and there is no extra switching and very seldom is a car disqualified.

Albert Chase (St. L.-S. F.): I would like to ask Mr. Owen if he has ever tried sand blasting to take the grease off.

Mr. Owen: Where it does not penetrate the floor.

J. E. Mehan (C. M. & St. P.): We find many cases where a car is unloaded and re-loaded before our inspectors have a chance to get in the car and classify it. I wonder if Mr. Owen has a remedy and what he does to overcome this.

Mr. O'Donnell: I think the selection of cars for our grain and flour business is a difficult problem. It depends on just how bad the oil spots are. If they are perfectly dry and not too deep we use the Wyndotte cleaner for cleaning the spots.

Mr. O'Donnell: I would like to ask Mr. Owen if the inspection made in his territory is by special inspectors and if the inspection is made at any other hours than during daylight hours.

Mr. Owen: In regard to the tin patches, it is well known by everyone that any movement of the sacks in the car will cause the tin to cut through the sacks. We never think of loading a car with tin patches on the floor, but we do put small patches over the cracks for the loading of grain. In regard to the daylight inspection that is the only way to inspect a flour or first class commodity car, although at times we are compelled to make inspections by our second and third trick inspectors.

E. R. Campbell (C. I. I., St. Paul, Minn.): In the Northwest, we load 400 cars of flour a day. We have twelve special inspectors at the mills that inspect the cars brought in by the railroads. We have a commodity card in the Twin Cities that is used for four purposes; one side, flour and grain and on the other side merchandise and rough freight or whatever commodity it is intended to handle.

As to the oil spots a great many of the railroads up there burn off oil spots that do not penetrate through the board. They burn off all these oil spots and when the cars come to the mill and our inspectors go over them again, if a small spot shows up, the mills for their protection put paper over that spot where the oil spot has been burned off. We have very few claims for damaged flour.

James Reed (N. Y. C.): When cars are plentiful the inspection is rigid, and when there is a scarcity of cars the bars are pulled down and we take almost anything.

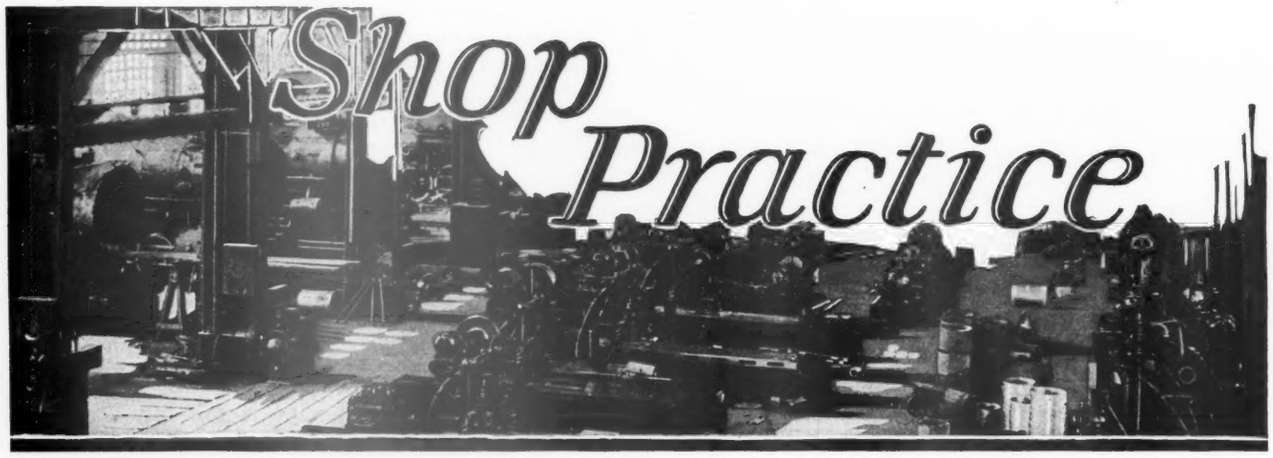
When the shippers load a number of cars with paper, a high class commodity, they have a habit of protecting the outside of the doors by tacking paper around the edges and regardless of the kind of car, they use cleats, with paper to keep the wind and rain out.

C. A. Merkes, (M. & St. L.): About six or seven years ago when eastern lines were sending their cars to our district for flour loading, oil spots were taken out with a quick drying paint. We tested with a sack of wheat that had been heated to 80 or 90 deg. F., using as many as four thicknesses of paper and found the oil penetrated into the sack. The painting of oil spots is not effective.

J. M. Acker (Ann Arbor): About two months ago a circular was put out giving a formula for cleaning grease and oil spots. I think you can all get it.

Secretary Sternberg: There seems to be a division of opinion and we cannot come to a conclusion, therefore I would like to make a motion that the president appoint a committee of three to investigate and report at the next convention.

(*The motion was carried and Mr. Owen given a rising vote of thanks for his instructive paper.*)



Record attendance at General Foremen's convention

Keen interest shown in papers on car maintenance and engine terminal operation—Selection of employees discussed

WITH a total registration of 650—of which 175 were members and 130 were railroad guests—the twenty-first annual convention of the International Railway General Foremen's Association, held at Hotel Sherman, Chicago, September 6 to 9, will go on record as one of the most constructive meetings held by this organization in recent years. The quality of the programs has improved from year to year and in this year's convention culminated in a well-balanced meeting in which the addresses and reports contained much of educational value to supervisors in the shop, engine terminal and car department.

Addresses were delivered by Samuel O. Dunn, editor, Railway Age; A. C. Mann, vice president, Illinois Central; T. W. Demarest, general superintendent motive power, Western Region, Pennsylvania; O. A. Garber, chief mechanical officer, Missouri Pacific; C. J. Wymer, superintendent car department, Chicago & Eastern Illinois; G. F. Hess, superintendent motive power, Wabash; and Hayes Robbins, formerly assistant to the president, Boston & Maine. In addition the following topics were presented and discussed: Handling locomotives at terminals; Terminal responsibility for car delays; Relation of reclamation to stock reduction; Passenger shop organization; How to obtain a higher standard of maintenance, and Determining the fitness of employees.

Election of officers

The following officers were elected to serve during the year 1927-1928: President, F. M. A'Hearn (Bessemer & Lake Erie); first vice president, J. H. Armstrong (A. T. & S. F.); second vice president, H. B. Sunderman (Hocking Valley); third vice president, A. H. Keyes (Baltimore & Ohio); fourth vice president, C. Y. Thomas (Kansas City Southern) and secretary-treasurer, William Hall. C. A. Barnes (Belt Railway of Chicago) was elected to the chairmanship of the executive committee together with the following members; A. T. Steeper (N. Y. C. & St. L.); W. J. McCloskey (Illinois Central); H. E. Warner (New York Central) and F. S. Wright (M. St. P. & Ste. St. M.).

The principal addresses

In speaking on the part the supervising officers play in controlling the efficiency of railroad operation Mr. Dunn said that, "in the long run, the ability of industry in general, and of the railroad industry in particular, to pay increasing average wages, depends upon increasing the total earnings of industry per man employed, and that this in turn depends in the long run largely or mainly upon enhanced efficiency resulting in increased average output per employee. The situation in the railroad industry is much the same as in other industries, excepting that the railways are earning a smaller percentage of return on their investment than most other industries.

Mr. Dunn's address

"In the year 1926 the total earnings taken in by the railways for each person employed by them were $3,581. This is the average wage that each employee would have received if the total earnings from freight, passenger and other business had been equally divided among all the employees. Why cannot all the earnings made, or at least a larger part of them, be paid to the employees? Few persons seem to know the answer to this question, but facts regarding the railroad business make it easy to answer. The average wage paid to all employees was $1,645. Of this $122 was paid from capital that was invested last year and $1,523 was paid from the year's earnings and charged to operating expenses. What was done with the rest of this $3,581? For locomotive

fuel there was paid out of it $229, and for materials and supplies used chiefly in maintenance, $681. You can no more run a railway without fuel for locomotives, and materials and supplies for maintenance, than you can run it without employees. There was paid out of it $58 for loss and damage to freight, injuries to persons and insurance, and $130 for depreciation and retirements. These, again, are operating expenses that are as unavoidable as wages. There was paid out, for each person employed, $218 in taxes. The railways have, of course, no control over the taxes they must pay. There was paid for each person employed, $62 for hire of equipment and rentals of joint facilities.

"These figures account for $2,900, or 81 per cent, of the $3,581 of earnings taken in by the railways per person employed by them. If the government owned the railways, or if the employees themselves owned them, these, or probably even larger, expenditures for fuel, materials and supplies, etc., would all have to be made, and, therefore, none of the earnings used for these purposes could be used in paying higher wages.

"There remained, after these operating expenses and taxes had been paid, $681 of earnings per employee. This is called 'net operating income,' and was used for paying interest on the debts of the railways, and dividends on their stock, and in making improvements. The investment in the property of the railways for each person employed by them was $13,330 and, therefore, this net operating income amounted to a return of only 5.11 per cent on the investment. Payment must be made for the use of capital if investors are to be induced to invest it in the railroad business, and certainly 5.11 per cent is a very modest return to be earned on investment in a year of record-breaking freight business such as 1926. The average return earned on the investment in the railroad business in the last seven years has been only 3.69 per cent.

"It follows that, in the long run, there are only two ways in which higher wages can be made possible. One of these is by increasing the total earnings of the railways per employee, either by increasing the average amount of traffic handled per man, or by getting higher freight and passenger rates from the traffic handled. The other is by effecting economies in the use of fuel and materials and getting reductions in taxes in order that a larger part of the total earnings may be available for paying wages. It necessarily follows that the average wage the railways can pay their employees depends upon the kind of regulation they receive and upon the efficiency and economy with which they prove to be operated.

"In point of efficiency our railroads will easily bear comparison with our other industries. It is highly significant that while the average wholesale price of all commodities is now 80 per cent higher than 37 years ago, the average yearly wage of railway employees about 230 per cent higher and their average hourly wage almost 300 per cent higher, the average rate received by

C. A. Barnes (Belt Ry. of Chicago) President

F. M. A'Hearn (B. & L. E.) First vice-president

J. N. Chapman (Illinois Central) Second vice-president

C. F. Bauman (C. & N. W.) Third vice-president

Wm. F. Hall Secretary-treasurer

the railways for the transportation of freight is only 14 per cent higher. Only by a vast investment of capital, and by increases in the efficiency and economy of operation probably unequalled in any other large industry have the railways succeeded in paying these greatly increased average wages, rendering their service to the public and earning comparatively small returns for the owners of their securities in spite of this comparatively very small advance in their average freight rate."

Mr. Demarest speaks on car delays

Mr. Demarest, in discussing "Terminal delays to freight cars" called attention to the fact that the railroads of this country had been able to handle the greatest volume of traffic in their history with not only no car shortage but with the existence of a material excess of rolling stock. His address was designed primarily to provoke thought on those factors resulting in freight car delays which the mechanical department has within its power to prevent. He enumerated a number of defects in car equipment that may be eliminated by more thorough inspection and an improvement in car maintenance. In concluding his remarks Mr. Demarest said "In reviewing the entire question I cannot see any new principles involved. The causes for delays and their remedy are in full view. The limit in operating and maintenance costs has not been reached and we have not yet begun to fully utilize or obtain paying service from our freight cars. Not only can the paying time of a freight car be increased, but by so doing the capital invested in freight cars be decreased. To obtain these results it may mean a change in policy and a change in methods. It certainly requires common action, not only as between the departments on an individual road, but also common action on the part of all roads. In the past we have been prone to say—'We cannot afford to do it.' It seems to me that we have reached the point where we must say, 'We cannot afford not to do it.'"

Mr. Hess talks on locomotive maintenance standards

G. F. Hess, in speaking on the manner in which it is possible to obtain a higher standard of maintenance, dwelt principally on the ways in which satisfactory results had been obtained on the Wabash and said in part:

It is my opinion that in order to obtain the highest possible standard of maintenance of equipment it is neceshary that you have the hearty co-operation of all employees. In order to get the equipment, particularly locomotives, to as nearly a perfect condition as possible, we started by interesting the enginemen and the firemen. We find that if we set a locomotive on the outgoing track ready for the run and have it in reasonably good condition, and have the interior of the cab, oil cans, shovel, etc., in a clean and orderly condition, when the engine crew arrives they immediately take an interest in their work, the result being they make a strenuous effort to go over the road without delay. Statements are made up each month showing each terminal from which locomotives are despatched, giving all concerned a list of the failures that have occurred on locomotives out of each terminal and calling attention to defects that could have been remedied before the locomotive left the terminal. In instances where a terminal has made a good performance, they are given a letter congratulating them for the efforts put forth. This letter does not simply include the general foreman, but all the men down to the wipers. We post letters from time to time commending the enginemen, firemen and shopmen for good performance.

As superintendent of motive power I try to make numerous trips over the line, stopping at the various enginehouses, and do not hesitate to talk to any employee whom I meet, congratulating him, or pointing out what could be done to better conditions, in this way stimulating interest and coming in personal contact with the men. It has built up one of the most loyal organizations that can be found on any railroad. At every terminal there is an effort being made to surpass the record of some other terminal. Competitive interest of this kind certainly leads to good results.

Referring to federal inspections, the following statistics will show what improvement has been made. For the year ending June 30, 1924, the government inspectors inspected 658 Wabash locomotives and found 72 per cent defective. For the year ending June 30, 1925, they inspected 702 locomotives and found 47 per cent defective. For the year ending June 30, 1926, they inspected 1,022 locomotives and found 23 per cent defective. For the year ending June 30, 1927, they inspected 1,075 locomotives and found 5.7 per cent defective. I think you will agree that this is a good record and was only brought about by the hearty co-operation and effort of everyone connected with the road.

On one master mechanic's territory, which consists of approximately 850 miles where we have approximately 250 locomotives assigned, they have made over two million locomotive miles without an engine failure. On the entire system for the month of June, 1927, we made 558,384 miles per failure in freight service and 125,873 miles per failure in passenger service. If there is any question as to what constitutes an engine failure on the Wabash, we would be glad to give this information.

We believe frequently there is not enough co-operation between the mechanical department and the enginemen. It is my belief that when you have the crews working with you and trying to help out, the handling and maintaining of equipment is much easier. We have instructed our enginehouse foremen, when possible, to meet the incoming enginemen at the cinder pit and talk to them concerning their troubles, but not to criticize. We know, frequently some wild statements are made by all of us and nothing will discourage a man any more than to be criticized or laughed at. Therefore, when we meet these men and they make suggestions to us, we should take them under consideration. Frequently there are times when small changes can be made on locomotives that will make for better conditions and when enginemen find the mechanical department is working with them and endeavoring to make conditions better you will have their whole-hearted support.

Abstracts of some of the reports follow and others will appear in subsequent issues of the *Railway Mechanical Engineer:*

Handling locomotives at terminals

By H. E. Bergstrom

Mechanical inspector, Northern Pacific, St. Paul, Minn.

The successful handling of engines at terminals is dependent upon the facilities and the organization. The economical handling of engines is dependent upon the methods employed. The facilities may consist of only a siding and a wye, with an engine watchman to care for the single engine terminating at that point; or, the facilities and organization may be the most complete to care for several hundred engines during a 24-hr. period. As all terminal facilities and organizations come within these two extremes, it is evident that the extent of the facilities and organization is dependent upon the num-

ber of engines being handled. The methods employed in the handling of engines vary with local conditions, the local organization, and the volume of engines handled through the terminal.

On arrival at large terminals, the engines are first attended to at inspection pits, located on the incoming enginehouse tracks. The volume of engines arriving at such terminals, necessitates obtaining the condition of each engine promptly in advance of its arrival in the enginehouse, and justifies maintaining an inspection force constantly on the inspection pits for this purpose. These inspection pits should be designed to permit ready use to and from them, and they should be sheltered to protect the inspection force from the inclemencies of the weather. When the inspection pits are located at some distance from the enginehouse, condition reports from inspectors and enginemen are sent by a pneumatic tube from the inspector's house to the enginehouse. At smaller terminals where engines arrive intermittently, inspection pits are dispensed with and inspections are made in the house.

The coaling facilities are located next to the inbound storage tracks or inspection pits, toward the enginehouse. The design and size are governed by the available room and the amount of coal to be handled. Large amounts of coal can be more economically handled by moving the car up an incline to the top of the dock where the coal is unloaded directly into pockets. Limited room necessitates dispensing with the long inclines, and mechanical methods of elevating the coal must be employed. At most terminals, locomotive cranes or hoists, generally used for other purposes, are brought into use in an emergency.

Properly arranged facilities assist performance

Sanding facilities are located next to the coaling facilities where engines are sanded. Good grades of sand are dried with stoves or steam and raised to overhead storage tanks with compressed air. From these tanks it falls by gravity, through hoses to the engine sand boxes. Sand storage bins should be of ample capacity to insure several months' supply, and the outlet hoses and valves should be of sufficient size to permit quick sanding.

The ash pits are next located toward the enginehouse. The size of ash pits and methods of ash handling depend on the number of engines being handled. For large terminals, gantry cranes, handling ashes direct from the ash pits to the cars, have been found to be the most economical in operation, while at smaller terminals, less expensive equipment will suffice. At other terminals, the amount of ashes to be handled may not justify any investment in ash handling facilities. Engine ash pans should be designed and constructed so as to permit the quick and complete removal of ashes. The complete removal of ashes while locomotives are on the ash pits, eliminates subsequent more expensive removal of ashes from enginehouse pits.

The turntable should be long enough to provide ample margin over the longest locomotive to be handled. Long tables facilitate moving locomotives not under steam into and out of the enginehouse, and reduce derailments to a minimum. Three bearing support tables now being placed in use facilitate the turning of locomotives, eliminating the necessity for accurate balancing.

The size of the enginehouse, which is the outstanding feature of the facilities, is governed by the number of locomotives being handled, the length of time such locomotives will be detained at the terminal, and the extent of repairs expected to be made there. They are generally equipped for blowing down boilers; they have hot water boiler washing plants; engine, tender, trailer truck and driving wheel drop pits, or drop tables; cranes of both portable and stationary design; steam and compressed air pipe lines; a good sewage system; substantial floors; and ample heating and lighting systems. In addition, most enginehouses have a two or three pit shop, adjacent to or connected with the enginehouse. These shops are equipped with drop pits or drop tables; they have a sufficient number of machine tools to handle driving box, rod and wheel work, safe-ending of boiler tubes, and blacksmith facilities. A boiler plant to supply electric current in emergency, water, steam and compressed air; an office building with lockers and washing facilities for enginemen and shopmen; a store building; standpipes for filling tenders located at various points, and outbound engine storage tracks, from which engines are dispatched, complete the general facilities of an engine terminal.

The enginehouse foreman the chief factor

Attending difficulties with any of the foregoing facilities, unless promptly taken care of and corrected, stop the flow of engines through the terminal, with resultant delays. It is therefore the organization which mans these facilities, that is held responsible for their proper maintenance and operation. Of this organization, the enginehouse foreman is the chief factor. He is directly in charge of, and responsible for, all the activities of his organization. In addition, he is the liaison officer between his organization and the transportation department. At small terminals he may, together with personally directing the work, do a considerable portion of it himself with the aid of an assistant at night. At medium sized terminals he will direct the outside work himself and have one or more assistants during the day, who share with him the responsibility of the enginehouse proper, and an assistant at night who is in complete charge of the terminal. At large terminals, his immediate staff will be still further expanded, and his duties will be largely managerial. Whether his duties are managerial, or whether he has direct supervision over all outside facilities, the logical place for his office is where he can command full view of the majority of these facilities, so that when in his office, he can see impending difficulties before they actually occur, or before being directly advised.

Under his direct supervision come the crew and engine dispatcher, who is held responsible for keeping in touch with locomotives undergoing repairs; receives orders from the transportation department for engines; sees that proper crews are called and that they report promptly for service. At the smaller terminal a majority of such details is handled by the enginehouse foreman, with the aid of a crew caller. The balance of the organization divides itself into two distinct groups: the sub-foreman or gang leaders with the mechanics and helpers engaged in making inspections and repairs, and the other group under the direction of gang leaders directing the ordinary labor, which handles the locomotives through the terminal and prepares them for service. The number of mechanics employed is governed by the amount of maintenance work required of the terminal, and general business conditions. The amount of ordinary labor is governed by the number of engines handled, climatic conditions and geographical location of the terminal. At the large terminals the house foreman has one or more clerks, who copy the work reported by enginemen and inspectors, and distribute such reports to the various sub-foremen or gang leaders. The engineer in charge of the power plant generally reports direct to the enginehouse foreman. It is this

organization that receive, inspect, repair, test, prepare and dispatch all locomotives so that they will again perform a cycle of work economically and without failure.

Method of inspection important

In order that the organization use the facilities to the best advantage, certain methods of controlling the movement of engines through the terminal, the proper methods of inspecting engines to prevent terminal delays and engine failures, and a logical method of controlling costs, must be employed.

From the time an engine arrives on the incoming enginehouse tracks, until it again leaves the outbound tracks, it is generally considered as being in the hands of the mechanical department. The shorter the time it is at the terminal, the more it will be in revenue earning service. Conversely, the longer it is at the terminal, the less will be the return upon the investment. In addition, the congestion of locomotives at the terminal will be greater, fuel consumption higher, less miles per locomotive will be obtained, and additional repairs will be found necessary.

In order to reduce this condition to a minimum, a majority of the roads compile and use a report (Fig. 1) showing the interval of time between the various progressive steps at the terminal. The form illustrated is probably the most complete of its kind, all others being an abridgment of this form. Not only does this report indicate exceptional time between the various steps through the terminal, but it readily indicates wrong conditions which must be promptly corrected. Exceptional time from "arrival at terminal" to "arrival at enginehouse" may call for prompt action in redistribution of forces. Exceptional time from "arrival at enginehouse" to "ready for service" may indicate any one

Movement of Locomotives at.....Terminal 12:01 A. M.....To 11:59 P. M.....19:...

ARRIVING												DEPARTING											
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
Loco. Number	Division	Train Number	Engineman	Fireman	Arrival at Terminal	Time from Terminal to Ashpit	Arrival at Ashpit	Time from Ashpit to Eng. Ho.	Arrival at Enginehouse	Time from arrival at Engine-house to Ready for Service	Time Ready for Service	Remarks	Train Number	Time Ordered	Engineman	Time Reported	Fireman	Time Reported	Time Leaving Storage Track	Time Leaving Terminal with Train	Time from Ready for Service to Time Ordered	Time from Arrival at Terminal to Departure	Remarks

Fig. 1—Report used for recording movements of locomotives at engine terminals

of a number of conditions. Proper co-operation may not exist between the enginehouse foreman and the storekeeper in that the former has neglected to inform the latter of exceptional requirements; or the storekeeper is waiting delivery of some finished castings or forgings from a distant shop point; or it may be found that the repair forces are not properly distributed. It may also indicate to the enginehouse foreman that he should have at hand extra air compressors, extra main driving boxes, engine truck boxes, tires, crossheads, pistons, cylinder heads, etc. If he can secure such material on short notice or by next train from the nearest shop point, such extra parts may not be required, but if he must wait on the foundry or shop to cast or finish such a part, he will want such extra parts at hand so as to enable him to keep his engines in revenue earning service. This report will also readily indicate the length of time from "ready for service" to "time ordered." As this time goes up, it quickly indicates a surplus of engines at the terminal, and he prepares to withdraw some from service temporarily, and leave them in a condition to be replaced in service upon a few hours' notice. In severe climates, where locomotives must be thoroughly drained to prevent freezing, the time from "ready for service" to "time ordered" is permitted to mount higher, particularly if this condition is considered only temporary.

Inspection a vital factor in reducing number of delays

Delays to train movements are generally considered as costing twenty cents per minute of train delay. This cost merely includes the operation of the train, and excludes all incidental costs such as repairs, investment return on the value of equipment involved, delays to perishable freight, and delays to other trains at meeting point.

The enginehouse organization is held responsible for initial delay to train movement through failure to provide engines at a designated time. It is also held responsible for delays in service, when engines cannot complete their cycle of work or cannot operate at their rated capacity. The inspection of incoming locomotives, whether it be done on inspection pits, or in the enginehouse is probably the most important part of the enginehouse operations, for thereon depends largely the successful operation of engines offered for service. Poor inspection results in defects being discovered by outgoing enginemen, causing terminal delays, and if such defects remain undiscovered they result eventually in engine failures. Inspectors, therefore, should be made thoroughly acquainted with all delays and failures, and if such schooling is not productive of good results, discipline is necessary.

Until recent years, such inspections have been considered sufficient for locomotives covering up to 200 miles in a cycle of work. Today, however, with long engine runs, many of which exceed 600 miles in length, the standard of inspection and maintenance must be raised to meet successfully the exceptional demands of the service. It is therefore considered by many roads in the country, that this method of inspection alone is insufficient. Instead of continuing engines in service until defects develop, such defects are being anticipated before they result in failure. While the practice is general of removing main and side rods, pistons, crossheads, piston valves, etc., for inspection to locate existing obscure defects and apply the proper remedy, no general practice exists as to the interval of time between such inspections. Some roads have adopted a 5 000-mile interval, others have placed such inspections on a 60-day basis, and still others on a 90-day basis. Each road appears to have adopted the interval between such inspections on the basis of service rendered by their locomotives. It is possible that in the near future some uniformity in time or mileage between such major inspections may be established, based on the service rendered. These major inspections do not eliminate the daily or trip inspection, but they will eliminate the necessity for intermittent major repairs, and permit of obtaining maximum mileage between such inspections with a minimum of terminal delay and engine failure. Time of the major inspections are spaced so that they will be made at the same time that other tests and inspections, designated by Federal Law, are made,

in order to reduce the time held out of service to a minimum.

Reduction in cost of paramount importance

With the facilities in good condition and the organization functioning properly, the terminal can dispatch engines through it with a minimum of time and effort, but there is still more required of the enginehouse foreman. In addition to dispatching engines promptly and in good condition, he must also do this at a minimum cost. The cost of handling locomotives at terminals is generally compared, one enginehouse with the other, and each foreman is interested in seeing that the cost of handling locomotives at his terminal approaches the minimum. Repairs that should be made today, but are postponed until some future date, build up deferred maintenance, and no savings are effected by deferring maintenance. Any saving, however, made in the ordinary labor handling of locomotives today, is an actual saving to the railroad.

Most roads have a daily form showing the ordinary or common labor cost of handling locomotives. A typical form of this kind is shown in Fig. 2. The

ENGINE HANDLING REPORT

STATION ..... 19....

ITEMS	TODAY	ACCUMULATIVE	
		This Month	Same Month Last Year
Roundhouse Foreman (Proportion)			
Roundhouse Clerks (Proportion)			
Hostlers			
Hostlers Helpers			
Truck Packer			
Cinder Pit Men			
Fire Builders			
Tool & Supply Men			
Grease Cup Fillers			
Boiler Washers			
Boiler Washers Helpers			
Sweepers			
Flue Cleaners			
Headlight Cleaners			
Wipers			
Engine Watchmen			
Turntable Men			
Callers			
Misc. Laborers			
Total Man Hours			
Total Cost			
No. Engines Handled			
No. Hours Per Engine			
Cost Per Engine			

..... Title .....

Fig. 2—Daily report form used for summarizing the ordinary labor cost of locomotive handling at terminals

number of man-hours required to handle a locomotive is recognized by most roads as the best gage by which performance can be judged. Man-hours per locomotive handled are more applicable than cost per locomotive handled, and deductions can be more quickly made by the enginehouse foreman as to how his performance is, and what it is likely to be, as soon as the number of engines handled increases or decreases. Due to the large variance in what constitutes an engine handled, costs of handling locomotives are not comparable between different roads. Theoretically it means that an engine is receiving a complete handling through the terminal, but in actual practice this is not true. The enginehouse organization is usually called upon to render service to switch-engines working on a two or three shift basis, and passenger and freight train engines running through the terminal and not detached from the train, which do not receive a complete handling through the terminal. In these cases, the enginehouse foreman takes credit for handling such engines according to his instructions. It would seem that some definite interpretations should be adopted by all roads, as to what constitutes an engine handled.

Inasmuch as the facilities of present engine terminals are already in existence and cannot be altered, except at considerable expense, it is the organization that must of necessity be adjusted to suit their design and arrangement. In addition, it is the enginehouse foreman that has put into practice general methods outlined by his superior officers, together with other methods, locally planned and adopted. The intelligent and energetic application of these methods will prevent delays. Cause of delay to engines are many and varied and frequently appear obscure. Reduction in delays, necessitates a thorough analysis of the causes. When the causes have been determined, the alert organization will apply the proper remedy to prevent their recurrence. The elimination of delays is an important factor in decreasing the cost of handling engines at terminals.

Terminal responsibility for car delays

H. L. Arnold (I. C.) as chairman of the committee on this subject submitted a report which may be summarized as follows:

A review of the situation concerning delays to freight cars reveals the fact that one of the greatest of car delays lies in the failure promptly to place bad order cars on repair tracks. This is a delay which may be minimized by close cooperation between the mechanical and transportation departments.

In repairing cars, loaded cars should be given the preference, with empty foreign line cars next, except where special conditions warrant deviation from this practice. Preference to foreign cars is justified by the per diem charged for foreign cars. When cars are carded for weighing the transportation department has the responsibility for weighing the car and the mechanical department for stencilling it. It is important that such cars should be stencilled and returned to the holding line as soon as possible. If foreign cars particularly are permitted to become delayed due to being carded for weighing we lose the amount we have made on the per diem and gain nothing for the labor involved in weighing the car. This also applies to cars carded bad order on account of triple valves, cylinders, etc.

Repairing passenger cars involves a somewhat different system than freight cars. It should be borne in mind that a passenger car must be in first class condition before departing from a terminal. A car which develops hot boxes resulting in delays to a train is charged as a terminal delay. Passenger cars should be carefully inspected in the coach yards before departing to the stations preparatory to the outbound trip. They should be again carefully inspected by passenger car inspectors at the station before the departure of the train to avoid terminal delays on the road after departure. Small items

such as a cotter key in a key bolt in the brake rod will sometimes cause serious delays as the lateral motion in the brake rod causes the key bolt to work its way out with the result that the bottom rod drops and sometimes derails a truck or tears brake rigging off. It is important that the piston travel should be accurately adjusted. At times cars after having been repaired are found with brake rigging that has not been properly put up and piston travel adjusted. Such a condition affects the braking power of the train with the result that serious accidents sometimes happen due to an engineman being unable to control his train.

Discussion

A. H. Keyes (B. & O.) outlined as follows, the system of "A" and "B" inspection that has been in effect on the Baltimore & Ohio for some time with the idea of properly placing the responsibility for delays or accidents to cars dispatched: An empty freight car placed for loading should be given a thorough and rigid inspection of all parts and such parts as arch bars, cast steel side frames, truck bolster and spring beam, column and journal box bolts, side bearings, wheels, journal boxes, draft gears, brakes, air brakes, etc., should be in perfect condition before the car is placed for loading, and in order to determine the fitness of a particular car for the particular kind of loading for which it is selected the car inspector should place a commodity card on the side of the car designating the commodity of the highest nature that the car is suitable for, which is not done until a thorough inspection is made of the roof, sills, safety appliances, doors, etc. This being done, it is considered that this car has received "A" inspection and is in such condition as to reach its destination.

A loaded freight car received at interchange will receive the same thorough inspection which an empty box car or other freight car receives when placed for loading, to insure that the car is safe and in condition to reach its destination without delay, due to mechanical defects or hot boxes.

A rigid or "A" inspection of a car should not again be necessary at other terminals through which the car would pass in proceeding to its destination. However, an inspection of trains is made at each terminal point for the purpose of detecting defects which would occur in ordinary train handling, which would be considered "B" inspection.

Should it be necessary to disrupt the train by throwing out a car on the line or at a passing terminal for such defects as sharp flanges or seamed wheels, cracked or broken arch bars showing old break, defective air brake equipment, when it has not been cleaned within the required 12 months, or any defect which could have been detected at the time a thorough "A" inspection was made of the car, the responsibility lies with the inspector who made that "A" inspection and such action taken with him as his past record would warrant.

The "A" inspection point would also be responsible for the proper condition of lading placed on open cars to see that it is properly secured in accordance with American Railway Association Loading Rules as revised from year to year by the association. This is especially true in regard to double, triple and superimposed loads.

When investigation and inspection is being made of lading placed in and on the car an equally rigid inspection as called for above will be made of the condition of the car to see that it is safe to carry the lading it is offered to hauling. If it is not in such condition the car should be repaired before the lading is placed on it or should be sent to the shop for proper repairs and a car suitable for moving the lading provided in its stead. When cars are loaded at outlying points where inspectors are not available arrangements should be made by the division master car builder or general car foreman of such territory with the agent to advise them when cars are to be placed for loading especially open top cars for double, triple or super-imposed loads, in order that the car might be inspected before it is loaded and the lading inspected before the car is moved, to insure it being in safe condition.

W. J. McCloskey (I. C.) said that direct mechanical supervision is desirable in car yards to avoid shopping cars that can be repaired in the yard or have defects that would safely take the load to destination. He also said that a complete inbound train inspection is extremely important in order to eliminate the necessity of switching out bad order cars from outbound trains. When, however, bad order cars are discovered in outbound trains immediate information should be given to the crew foreman in charge of the yard so that the car in question may be switched out before the road engine arrives. He also said: "There is no one condition known to me that results in delay or more interruption of traffic than the supposition that because a car came in it can go out of a terminal. Cars are no different from locomotives except that they are subject to more abuse and less attention. Some consignees of freight feel privileged to mutilate the floor and sides of cars when unloading their shipments and they are the first to complain if first class equipment is not always available immediately before their order and if their attention is directly called to the damage they are causing to cars, they many times retaliate by diverting their traffic to other routes. The terminal delays to bad order cars can be materially reduced by placing repair facilities in close proximity to the train yard. It is important that cars with minor defects be so carded and placed that cars having defects requiring heavy repairs will not delay cars needing only light repairs."

How to obtain a higher standard of equipment maintenance

E. J. Burck (M. C.) submitted a report, of which the following is an abstract: The maintenance of a locomotive begins the day it is received from the builder, first in the enginehouse and later in the shops. Motive power must be maintained at a high standard and it must be efficiently operated at the same high standard. The engine terminal is the pulse of the motive power department; if you have a sick engine terminal, you certainly get motive power incapable of making successful trips. Modern locomotives are equipped with special appliances, which are operated by air, steam or electricity, to increase their hauling capacity; all these add materially to the maintenance of locomotives.

In reality, the maintenance of a locomotive begins on its arrival at the cinder pit after completing its run. At this point the engineman gives the locomotive an inspection and reports conditions found, also other observations that he may have made while en route. An engineman rarely gives a locomotive a thorough inspection and I contend that a mechanic should meet the locomotive, as it is delivered to the pit, and there make a joint inspection with the engineman. If a bad pound has developed, this can be easily traced by both engineman and inspector, while making a joint inspection. An outside inspection in daylight gives good results, particularly if made before the fires are knocked out. Fractures are more readily discovered on both rods and

motion work, also the condition of the tender and parts above the running board; boiler mountings in the cab can be more readily inspected and defects more easily found.

There are different methods of handling work reports from both enginemen and inspectors. One form commonly used is the book form, in which reports are written by a clerk who copies the work reported on work slips, printing one item on each slip. These slips are then handed to the men assigned to do the work. Another form is the single blank on which all reports are recorded and the blank is placed under glass on a post next to the locomotive, from which men work and sign up for their own class of work recorded on this sheet. Just recently we have adopted the latter method and find that better results are obtained.

Some of you will not agree with me that heavy work should be done in enginehouses. Conditions on your road may not compare with those on others. Some roads do not give a classified repair credit unless the mileage

MONTHLY MACHINERY INSPECTION AND WORK REPORT ON

Engine No._____

Work done at _____ (enginehouse) Work done on _____ (date)

Were both pistons disconnected from crossheads and examined for cracks?_____
Were piston heads and packing examined both sides?_____
Were both valves pulled, bushings examined and necessary work done?_____
Were necessary repairs made to crossheads and guides?_____
Were all rods removed and examined for cracks?_____
Were side rod bushings renewed?_____
Were main rod brasses renewed or reduced?_____
Was the necessary work done to shoes, wedges and binders?_____
Was necessary work done to valve gear?_____
Was necessary work done on engine truck?_____
Was frame examined for broken bolts?_____
Was necessary work done on trailer?_____
Was necessary work done on booster?_____
Was necessary work done to feedwater pump?_____
Was feedwater tube bundle washed?_____
Was lubricator cleaned?_____
Was train control and lighting system inspected?_____
Was necessary work done on spring rigging?_____
Was necessary work done on brake rigging?_____
Was necessary work done on tender trucks?_____
Was necessary work done on tender frame?_____
Was necessary work done on water scoop?_____
Was necessary work done on tender brake rigging?_____
Was necessary work done on tank?_____
Were units tested?_____
Were perforated plates removed from driving box cellars and cleaned?_____
Were engine truck, trailer truck and tender truck brasses examined?_____

Signed _____
Enginehouse foreman

Form for checking the performance of the monthly maintenance program

is high enough and repairs made warrant the dropping of mileage. Again others call intermediate repairs between shopping classified repairs and no mileage is dropped.

In enginehouses where heavy repairs are made this work is separated from regular engine house routine work. A special gang, known as the drop pit gang, supervised by a drop pit foreman, handles this work. This drop pit foreman works under the instructions of the superintendent of shops and the enginehouse foreman. Drop pit forces work shop hours and are known as part of the shop forces.

The maintenance of a locomotive must be studied, and if a failure occurs the cause of the failure analyzed. In a great many cases it is the design of certain parts and it is up to the supervision to recommend a change, if necessary, so that failures will not re-occur.

Present traffic conditions demand that engines stand up to their requirements. Locomotives of today are required to handle heavier trains and make longer hauls. We must not think that it is only the machinery that needs the attention, but remember that the boiler must be given equal maintenance and must not be neglected. A little inspection by a supervisor after the boiler work is completed will give wonderful results. Flues sometimes are not properly cleaned and, with some styles of superheater units it is absolutely necessary that we have clean flues. Be an inspector yourself and see what you can find that is not properly done. After you have noticed the boiler work checked off, send an inspector into the fire box and have him report to you the conditions found; if the work has not been done properly, discipline the employee who is responsible; it will affect the men on other shifts.

Each road has its own method of inspecting and maintaining its locomotives. The enginehouse foreman is the main cog in the wheel in the efficient handling of locomotives in the enginehouse. He must keep the general foreman or superintendent of shops posted at all times of conditions of power, and he should be able to give advance information concerning certain parts of the locomotive such as cylinders, superheater headers, etc., that may need renewing when the engine is due for the shop.

To maintain power it is necessary to give locomotive parts periodical inspections. In order to make a check of these inspections we have adopted the following form:

I believe the enginehouse foreman should also attend shop foremen's weekly meetings and call their attention to work not properly done in the shops, in particular, work which will not pass federal inspection. The enginehouse foreman should consider it a privilege to attend these meetings and be able, by constructive criticism from maintenance experience, to advise the shop forces wherein they fail to turn out a locomotive equal to the demands of the service. This shop foremen's meeting I am talking about is not a schedule meeting but a weekly meeting held after shop hours at which time matters are discussed as to safety, shop improvements, letters read concerning all foremen, articles discussed which appear in mechanical magazines, etc.

We request the enginehouse foreman, assistant enginehouse foreman, enginehouse and shop boiler foreman, enginehouse engine inspectors, foreman of erecting floor, pipe foreman, general machine foreman and machine foreman of motion work, rod work and wheel work to ride engines, with instructions to observe the parts which they inspect or supervise and give a written report of their observations. We generally pick the run for these men to ride, with instructions to enginemen to give them a good ride. We find this has a good effect on supervisors and they realize the importance of their position and many good suggestions have been made and better work done.

Federal and state standards present difficult problems and our officers have adopted many mechanical instructions to prevent their violation. There is no argument against the rules and standards as applied to locomotives by the Interstate Commerce Commission and public service commissions. They have been instrumental in establishing the present high standard of locomotive condition. Living up to their high standards has been one of our problems, but the fact should not be lost sight of that additional man-hours are necessary to maintain the standards prescribed as compared with the time required before the creation of these public service bodies.

In conclusion, let me put stress on this point: that to obtain a higher standard of equipment maintenance, it

is necessary that each of the physical conditions of your equipment be known and also that you know how to handle them. This may be done by keeping yourself posted, by noting how the other fellow handles this work, which information can always be found in the mechanical publications which are so numerous at the present time.

Discussion

During the discussion of this report one member took exception to the suggestion in the report that it is advisable to have enginemen and inspectors make joint inspection of locomotives at terminals, his contention being that the engineman who has had an opportunity during the trip over the road to observe the performance of the locomotive is in much better position to make an intelligent report of defects developing en route and that he has knowledge of defects which would not be visible to an inspector while the locomotive is on the inspection pit. There was some difference of opinion as to the advisability of making heavy repairs at engine terminals, the suggestion being offered that such repairs should be made at the main shops where proper facilities are available for handling locomotives. The conclusion to be drawn from the discussion, however, would seem to indicate that a decision would depend to a large extent upon the facilities available on individual roads at both the engine terminal and the main shops. To bring about a higher standard of maintenance, the discussion indicated that most members were in favor of the practice of periodical repairs to locomotives, including heavy running and light classified repairs at engine terminals where facilities permit. Several members who have had experience with scheduling systems for engine terminals indicated that such systems are valuable in speeding up the work.

Cart for handling driving wheel tires

By C. F. Barnhill

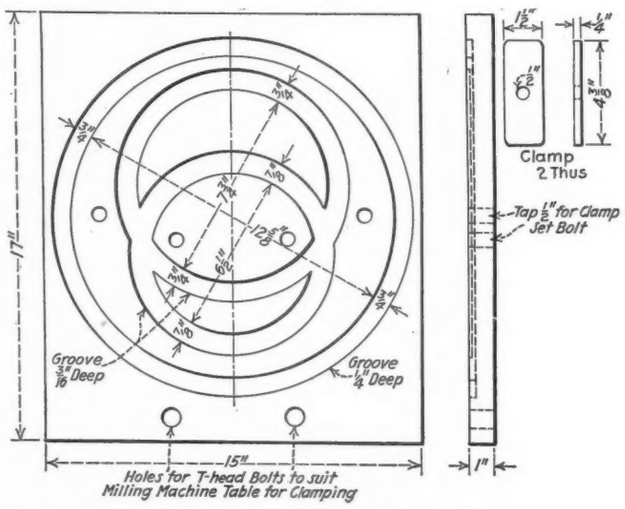
Division master mechanic, Gulf, Colorado & Santa Fe, Silsbee, Tex.

IN the illustration is shown a cart for handling locomotive driving wheel tires which was built with the object of preventing possible injury to workmen and also to protect the brick floor in the enginehouse from wear when rolling tires. Two men can handle any size tire with this cart without danger of its upsetting. Tires are picked up or lowered to the ground by raising the handle, which lowers the upright and enables the tire to be chained in the frame, as shown in the illustration.

This cart eliminates the necessity of rolling tires with the attendant possibility of injury to workmen and the floor

Milling dowel space in valve rings

THE device shown in the sketch for machining dowel space in valve rings consists of a 1-in. plate which is clamped solidly to the bed plate of a milling machine with two 5/8-in. bolts. It was developed by one of the employees of the Lehigh Valley shops at Sayre, Pa. Three grooves are machined in the top of the plate into which can be fitted any one of the three sizes of valve rings used on Lehigh Valley locomotives. The valve ring is held in place by two small clamps secured with



Sketch of device used for milling dowel space in valve rings

½-in. set screws. With this device the milling cutter not only removes the metal for the dowel space quickly and accurately, but also gives a satisfactory job. The device is easily set up and gives a machine finished job in one operation.

The old method of removing the metal for the dowel space was to drill two holes through the ring, then place the ring in the device and file out the remaining metal. The disadvantage of this method as compared to the one just described is that two operations were necessary and considerable time was required due to the fact that it was a hand-finished job.

THE AGE OF RIVETED STEEL.—On August 26, a moving picture, entitled "This is the age of riveted steel," was exhibited to a group of Pittsburgh & Lake Erie railroad men at Pittsburgh, Pa., this film having been shown on a number of similar occasions during the past few months by the Hanna Engineering Works, 1771 Elston Ave., Chicago. It is an educational film, illustrating the manufacture of rivets and their application to steel structures such as cars, boilers, tanks, bridges and buildings, incidentally affording convincing evidence of the vital part which rivets play in modern structures of all kinds and how much dependence is placed on their reliability. The film, printed on non-inflammable stock of standard width in three reels which take about 40 min. to run, can be secured for the use of railroad clubs and associations by communicating with the Hanna Engineering Works.

Tool foremen hold annual meeting

Chicago convention continues work on standardization—Addresses by B. N. Lewis and H. P. Allstrand

THE American Railway Tool Foremen's Association held its fifteenth annual convention at the Hotel Sherman, Chicago, August 31 to September 2 inclusive, two outstanding features of the program being addresses by B. N. Lewis, mechanical superintendent of the Minneapolis, St. Paul & Saulte Ste. Marie, and H. P. Allstrand, assistant superintendent of motive power of the Chicago & North Western. As usual, the outstanding work of the association is being done in connection with standardization of small tools.

Mr. Lewis said that a railroad repair or manufacturing shop is no better than its toolroom and related equipment and that the toolroom of any shop is the best indicator of its efficiency and progressiveness. He emphasized the need of selecting the right type of men to supervise tool work and outlined briefly the major problems of toolroom foremen, explaining the necessity, when new rolling stock is purchased, of providing an adequate ratio of new equipment for toolrooms and shops. The purchase of modern locomotives and cars without regard to shop facilities to maintain them was said by Mr. Lewis to be an unwise policy.

Mr. Allstrand devoted his remarks to a discussion of the use of jigs and devices in railroad production work. He pointed out that the quality of jigs and labor-saving devices developed at any shop also is indicative of the morale and spirit of the shop organization, the most convenient devices frequently being found in the most poorly equipped shops and therefore affording the only means of keeping pace with plants much better equipped. Mr. Allstrand said that because an idea is clever or ingenious does not prove that it is practicable, and a little time spent prowling around the back corners of the average railroad toolroom or shop will produce ample evidence of this fact, or at least bring to light many misspent ideas or ideas that have apparently outlived their usefulness. Mr. Allstrand believes that the development of efficient jigs and devices is important enough to

O. D. Kinsey (C. M. & St. P.)
President

E. A. Greame (D. L. & W.)
First vice-president

W. R. Millican (M.-K.-T.)
Second vice-president

H. P. Jones (Oregon Short Line) Third vice-chairman

G. G. Macina (C. M. & St. P.)
Secretary-treasurer

be handled by the best man obtainable, if possible, a specialist who can pass on each suggestion, carrying it to a conclusion and see that it is put into effect.

Election of officers

At one of the regular sessions, the association elected the following officers for 1927-28: President, E. A. Greame, Delaware, Lackawanna & Western, Scranton, Pa.; first vice-president, W. R. Millican, Missouri-Kansas-Texas, Parsons, Kans.; second vice-president, H. P. Jones, Oregon Short Lines, Pocatello, Idaho; third vice-president, A. A. Ferguson, Missouri-Pacific, St. Louis, Mo. G. G. Macina was re-elected secretary-treasurer. The following new members of the executive committee were elected: J. Carroll, Chesapeake & Ohio, Huntington, W. Va.; H. L. Taylor, Baltimore & Ohio, Baltimore, Md., and E. J. McKernan, Atchison, Topeka & Santa Fe, Topeka, Kans.

Report on standard taps and dies

The taps and dies covered in this report, read by Chairman A. A. Ferguson, tool supervisor, Missouri Pacific, St. Louis, are for rethreading only and not for new work, which is usually performed by machine.

The American Railway Association has adopted standard threads for crosshead pins, crank pins, knuckle pins and piston rods, and the hand taps for rethreading nuts for these pins as discussed and finally approved by the American Railway Tool Foremen's Association, are shown in Fig. 1. They are all U. S. S., eight threads per inch, differing only from the taps originally suggested by the committee in that the shanks are increased to .005 in. under the root diameter of the thread, and the squares in the two larger sizes are increased to 1½ in. to obtain a better proportion.

These taps are designed with six flutes, tapered back approximately three threads to permit the tap entering threads which are burred or distorted and cleaning them before the full thread enters. All taps are relieved in the thread, the flute forms being left to the judgment of the manufacturers.

The general adoption of these taps will be a step in the right direction as 10, 12 and 8 threads per inch, sharp V form in all sizes, are now used by various roads.

Die nuts recommended by the American Railway Tool Foremen's Association for chasing threads on bolts and on the standard A. R. A. crosshead pins, crank pins,

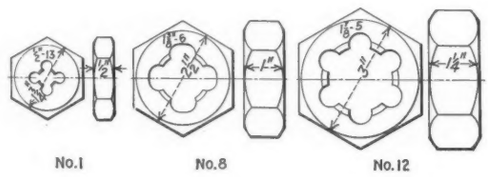


Fig. 2—Die nuts for chasing threads on bolts with U. S. S. form of thread

knuckle pins and piston rods mentioned are shown in the following table:

Standard die nuts with U. S. S. form thread

No.	Thread size	Threads per in.	Distance across flats	Thickness of die nut
1	½ in.	13	1¾ in.	½ in.
2	⅝ in.	11	1¾ in.	⅝ in.
3	¾ in.	10	2 in.	¾ in.
4	⅞ in.	9	2 in.	⅞ in.
5	1 in.	8	2¼ in.	1 in.
6	1⅛ in.	7	2¼ in.	1 in.
7	1¼ in.	7	2½ in.	1 in.
8	1⅜ in.	6	2½ in.	1 in.
9	1½ in.	6	2¾ in.	1⅛ in.
10	1⅝ in.	5½	2¾ in.	1⅛ in.
11	1¾ in.	5	3 in.	1¼ in.
12	1⅞ in.	5	3 in.	1¼ in.
13	2 in.	8	4½ in.	1¼ in.
14	2¼ in.	8	4½ in.	1¼ in.
15	2½ in.	8	5 in.	1¼ in.
16	2¾ in.	8	5 in.	1¼ in.
17	3 in.	8	5 in.	1¼ in.

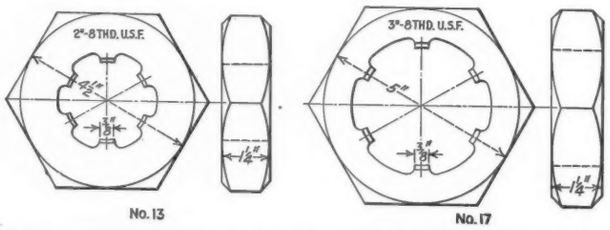


Fig. 3—Die nuts for chasing A. R. A. standard threads on wrist pins, knuckle pins, etc.

Owing to space limitations, drawings of all the die nuts cannot be included, but Nos. 1, 8 and 12 for chasing

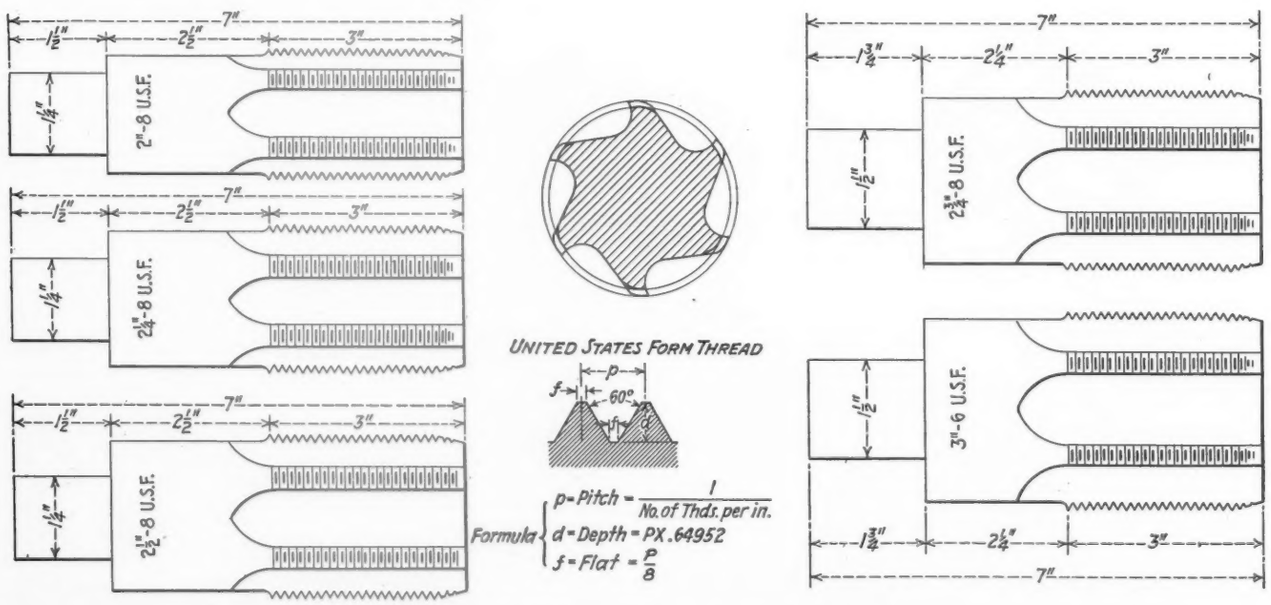


Fig. 1—Hand taps for chasing A. R. A. standard bolt threads

bolt threads are shown in Fig. 2, and Nos. 13 and 17 for chasing crank pin threads, etc., are shown in Fig. 3. The die nuts, as originally suggested by the committee, were accepted and approved by the American Railway Tool Foremen's Association with the provision that the threads be relieved and chamfered on one side only, two threads back. The committee called attention to the fact that in each case there are die nuts for two sizes of bolts having the same dimension across the hexagon. This has the effect of reducing the number of wrenches for handling this class of tools. The die nuts are also designed larger across the hexagon than present commercial standards which are found too light for railroad work. The committee reports frequent breakage of commercial die nuts due to too much chip clearance which is not necessary for rethreading. In designing the die nuts illustrated, the chip clearance has been reduced.

It will be noted that all of the die nuts for rethreading crank pins, knuckle pins, etc., may be used with two-wrench sizes.

Report on standard gage and measuring systems

Interchangeability may be difficult when parts are made in different shops and different gages or gaging systems are used. In the manufacture of standard parts, it is not only necessary to have instruments to measure to those limits required, but it is necessary to have instruments to check the instruments or measuring system used.

(The committee here dwelt at some length on the subject of the Rockwell, Schleroscope and Brinell systems of hardness testing, explaining the operation and results possible with these hardness testing instruments and expressing the opinion that they are valuable for determining the quality of metals received and should be considered a permanent fixture for the toolrooms of large shops. It was also said that they afford an effective check on the quality of tools manufactured and purchased locally.—Editor.)

Vernier caliper for producing accurate gages

The vernier caliper, while not used in its commercial form in railroad shops to any extent other than in toolrooms, may well find more extensive application in the future.

A vernier gage has recently been produced for use in gaging rod trams. This gage, as illustrated, is a valuable assistance in rod work. The commercial vernier, of course, finds its place in the toolroom and is employed in gear checking.

Gaging of screw threads in locomotive shops

A set of what is known as "Standard screw thread size plates" is placed in service at every screw cutting machine and the tool foreman has a set of standard master gages in the toolroom with which the above-mentioned gages are tested whenever it is deemed necessary. The latter gages are never used except to test the service gages. The service gages are made from an alloy steel which will not shrink nor warp easily when being tempered.

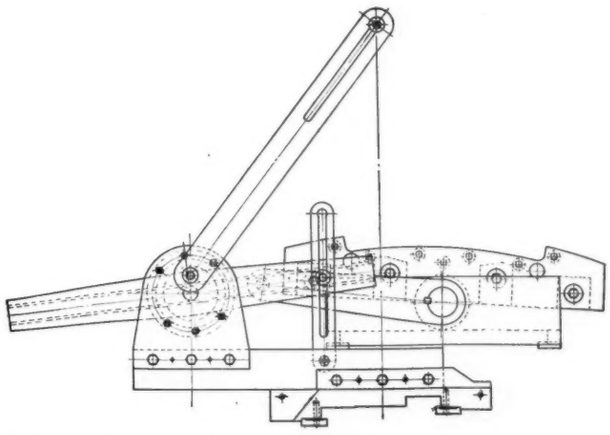


Fig. 5—Radius milling attachment for use on knee type milling machine

Micrometers

The micrometer has found its way permanently into the locomotive repair shop. Toolrooms should be equipped with both inside and outside micrometers, ranging in size from 0 to 14 in.

The mechanic today does not care to use the spring caliper and the railroad companies themselves do not care to have their workmen use the old calipers on such jobs as driving axles, crank pins and on other work where exact fits are required.

The micrometer has found its way into machine construction, the feed handles on all modern machines being

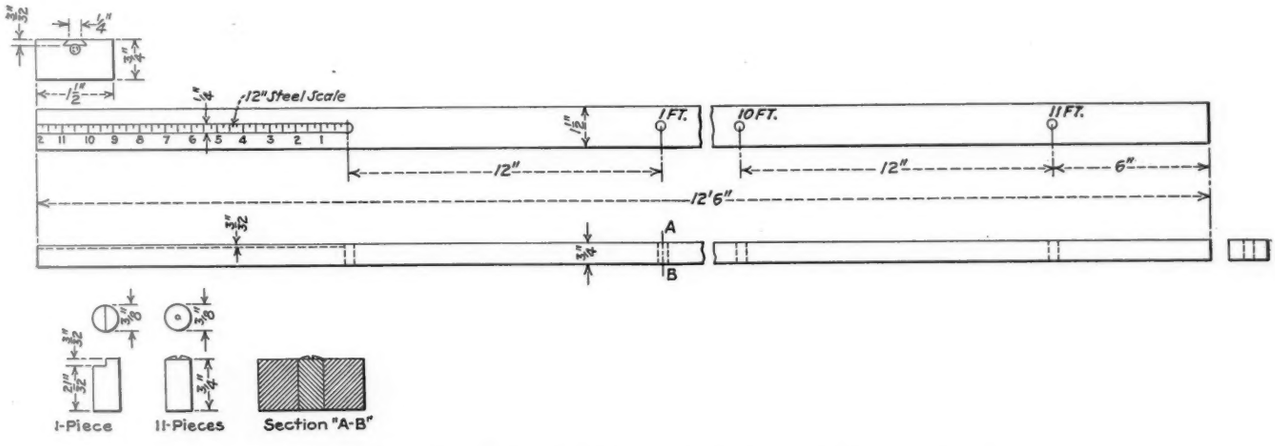


Fig. 4—Locomotive rod tram gage with vernier attachment

graduated in thousandths which makes it easier for the operator to produce accurate work.

Dial indicators and plug gages

Dial indicators are used mostly in the toolrooms of locomotive repair shops and to some extent in the machine shops on layout tables. It has found a place in the shop for checking work and in the larger shops is part of the tool equipment.

Plug and ring thread gages for checking pipe size threads on boiler fittings, for checking sizes of staybolts, boiler studs, standard studs and bolts should be hardened and ground gages. The taper gages for pipe threads and taper boiler studs can be made with solid rings and plugs.

The gages used on straight work, such as staybolts and standard bolts should have adjustable rings and the plugs should be made reversible and fastened to the handle with a screw, so that when one end becomes worn, the plug may be reversed. These plug gages should be kept in the toolroom for reference. They will save a great deal of trouble and argument and will more than pay for themselves.

Hardened and ground ring gages can be used for checking locomotive frame reamers, 1/16 in. taper per ft. These gages are rings or discs 3 in. in diameter and 1 in. in thickness. The holes are ground 1/16 in. taper per ft. and are sized at the small end of the hole, varying in 1/32 in. from 7/8 in. to 2 1/16 in., so that if two gages are placed on a reamer, for example, the 1¼ in. gage and the 1 9/32 in. gage, they will measure six inches apart center to center if the taper of the reamer is correct. Of course, on the longer reamers three or four of the gages may be used, so as to check every six inches of its length.

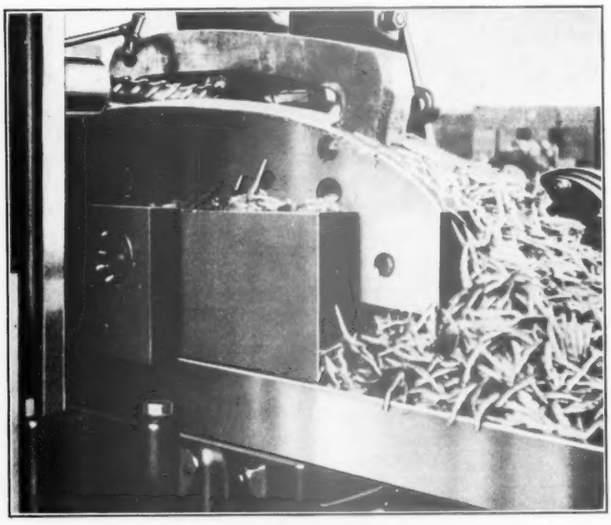


Fig. 6—Link after the radius has been milled

As we get further into interchangeable work on locomotives, more gages will be used and we will have to tighten up on inspection in order to have locomotive parts fit together more closely. The report was signed by M. B. Roderick, Erie; C. Helm, Chicago, Milwaukee & St. Paul; J. T. Sumner, Michigan Central; R. L. Nutter, Boston & Maine; D. L. Grady Atlantic Coast Line and H. P. Jones, Oregon Short Line.

Report on shop kinks

The report of the committee on small tools and devices for locomotive and car shops in the absence of the chairman was read by W. R. Millican tool foreman of the Missouri-Kansas-Texas at Parsons, Kan.

A large number of photographs and drawings of various labor saving devices were exhibited about the convention hall, one of those which attracted the most interest being shown in Figs. 5 and 6, which illustrate a radius milling attachment for milling machines. Referring to Fig. 5, the arrangement of the attachment is indicated. The radius is obtained by the angle of the sine bar. The chuck or work holding fixture is mounted on the table of the milling machine while the sine bar is secured to the knee of the machine and braced from the machine arm. Any radius within the range of locomotive links can be obtained by changing the angle of the sine bar.

In operation, a blank is set up in the fixture, a suitable hole having previously been drilled for the insertion of helical milling cutter. The link after the radius has been milled is shown in Fig. 6, which also indicates the amount and character of the chips made by this milling cutter.

The machining time for a single cut is 21 min. and a link of average size can be machined complete on both inside and outside radii within 1½ hours floor to floor, after the fixture has been applied to the machine. An accurate, smooth and generally satisfactory job is obtained.

Report on heat treating methods and equipment

The first point to take into consideration before making any recommendations and one on which the entire subject depends is the method of handling these tools on the various roads. We feel and recommend that in order to install the proper equipment and eliminate, as far as possible, failures due to incorrect heat treatment, the handling of all tools requiring heat treatment should be taken care of at a central point, as far as consistently possible with the needs of the system, or failing this, that it should be handled at as few points as can be arranged, due consideration being given to necessity of handling to and from this point and to the needs of the individual stations. This being done, it is then possible to install proper methods, which would be entirely impracticable as a recommendation for installing at all or any small points.

For the proper discussion of the subject we have divided it into three sub-divisions, as follows. Manufacture of and repairs to chisels, caulking tools and similar tools; manufacture of and repairs to high speed machine tools; and manufacture of and repairs to reamers, taps, rivet sets, etc. Taking these up in order, the type of heat treating equipment to be recommended depends on the different practices on these particular items.

Manufacturing chisels

The first consideration to be given in the treatment of chisels (and for the purpose of this discussion, the word chisels will be used to denote caulking tools and all other tools of similar nature), is the forging. This is the point that causes more failures than any other as, if this is not properly done, then all subsequent processes, however carefully they may be done, are utterly useless. It is essential in forging that the blanks be preheated sufficiently to take out the strain before being placed in the forging furnace, particularly where the blanks are subject to severe cold. They should then be heated back sufficiently far from the end to not above 1,700 deg. F., or an orange heat, care being taken to see that the heating is not done too rapidly and also that the heat has pene-

trated entirely through the steel, or in other words to see that the surface is not being worked at one temperature and the core at another. This is not to be construed, however, as favoring soaking after the tools have reached the proper heat, as this is as bad as not heating sufficiently. They then should be forged as rapidly as possible, finishing the forging at a dark red heat with light blows in order to secure the utmost refinement of grain. The tools should then be reheated to approximately 1,450 deg. F., or bright cherry, to take out working strains, and allowed to cool. This should be done preferably in lime, if possible, as this puts the steel in the best possible condition for the hardening and tempering operations.

For hardening, the tools should be preheated to at least 300 or 400 deg. F. by placing on top of the furnace or hot plate and then placed in a semi-muffle type furnace with a reducing flame and heated to between 1,425 and 1,475 deg. F., according to the carbon content and size, the lower figure usually being the most desirable for chisels and similar tools; or they can be heated in a lead bath which can be held to the exact temperature desired and which eliminates oxidation. The tools are now quenched as rapidly as possible in order to prevent any scale accumulation, which gives unequal hardening and any drop in temperature before quenching. The quenching should not be done on a line, that is, the tools should be moved up and down so that there will not be any distinct line between the hardened and softer sections, but a gradually decreasing hardness. Water kept between 70 and 100 deg F. is preferable for the quenching medium for these tools. The tools should then be drawn either in a bath or by the color method to suit the particular conditions the tool is to encounter.

For equipment for the central point any type of semi-muffle furnace or lead bath will give good results and should be equipped with pyrometers which should be checked frequently. The quenching tank should be of sufficient size so that the temperature will not rise too much as this gives an uneven hardening. Some form of cooling system can be installed at little expense if necessary for larger stations either water in coils or a jacket around the tank or air to agitate the water or any combination.

Manufacture and repairs to high speed machine tools

The same conditions that make for centralized manufacture of carbon tools are even more imperative for the proper manufacture of high speed tools and these should be centralized at as few points as possible. The increased life and efficiency of perfectly treated tools more than offset any difficulties which might occur due to this practice.

High speed tools should be treated through thoroughly before being placed in the forging fire as the alloys which give this steel their properties likewise render it exceedingly dense and slow to react to heat. The fire should be free from excess air and have a deep bed of coke. The tools should be heated thoroughly on the end to be forged to a temperature of 2,000 deg. F., or a light yellow and forged rapidly. If cooled below 1,600 deg. F., or a dark orange, before forging is complete, they should be placed back in the fire and reheated, this being repeated as often as necessary. The tool should not be heated farther back than is necessary to shape it, but far enough so that no work will be done on any portion below a bright cherry.

After the forging is complete the tool should be normalized, that is, brought to 1,400 deg. F. and then cooled in the furnace or in dry lime or ashes.

It should then be heated through thoroughly, then placed in the fire and heated slowly to about 1,600 deg. F., then brought rapidly to 2,350 deg. F., or a bright white heat, and held there until the nose sweats freely and then cooled in a dry air blast or quenched in oil. A preheating furnace can be used to bring the tools to 1,600 deg. F. and then it can be placed in a high temperature furnace and held at 2,500—2,600 deg. F. and kept there until the nose sweats, and then cooled.

The tools should then be drawn, preferably in a lead bath, to 1,075—1,100 deg. F., which materially increases their life, reduces breakage and relieves hardening strains. This should take about a half hour at the required temperature.

The preferred type of equipment for a central point is a double deck furnace, semi-muffle type with the waste gases from the high heat utilized in the preheat chamber. This is economical in heat and space and also desirable from a handling standpoint. A lead bath can be used similar to the one for the carbon tools. If oil is used for quenching, a suitable tank with cooling arrangement must be installed and if air is used a separator should be used in the line immediately adjacent so that dry air is assured and a reservoir installed so that uniform volume is secured. The air is played directly on the nose of the tool. Drawing should take place before the tool cools entirely.

For dressing in small shops the forge previously described can be used to advantage, the drawing being done to color, but this is subject to more fluctuation in results.

Manufacture and repairs to reamers, taps, rivet sets, etc.

All special tools, whether carbon, alloy or high speed steel should be manufactured at one central point, as there is no reason for any other practice with these tools. Heat treatment, of course, is according to limits laid down and worked out to best advantage in your own shops. For this purpose the double deck furnace previously desired is admirable, costs less than two furnaces, one for pre-heat and one for high heat, but, of course, where the carbon tools are in excess, then for this purpose, one furnace should be provided for lower heats and one for higher heats.

Insofar as to the types of furnaces recommended, this more or less depends on the locality of the shops as in different instances, electricity, gas or oil might be the cheaper medium to employ. It is undoubtedly true that for carbon steels, the electric furnace prevents oxidation and gives an easily adjustable, uniform heat, but for high heat up to a few years ago the electric furnace was expensive, hard to maintain and not generally used nor recommended, nor is it used in the larger manufacturing plants today. However, in the last few years, electric furnaces have been brought on the market which seem to meet all objections and should be thoroughly investigated. The ideal layout for the hardening room is shown on the attached sketch.

The report was signed by Chairman H. L. Taylor, Baltimore & Ohio; N. W. Johnson, Illinois Central; C. H. Lewis, Gulf, Colorado & Santa Fe; J. M. Blue, Missouri Pacific; J. T. Jones, New York Central, and L. J. Franks, Erie.

MECHANICAL ENGINEERING GRADUATES.—A booklet giving a brief description and a picture of each of the individuals composing its senior class in mechanical engineering, has been published by The Pennsylvania State College, State College, Pa., in an endeavor to facilitate matters for the interviewer going to State College with a view to employing a college trained man. The booklet contains also a list of the juniors who are interested in securing summer employment with firms willing to take on men temporarily prior to graduation.

The Reader's Page

Have You a Question? Ask it
Have You an Opinion? Express it

"Jack" still center of heated discussion

Comments continue to reach the Reader's Page concerning the question asked in the August number, as to whether Jack who refused an increase which was offered him over and above the standard rate paid to his fellows, and who seemed to be ambitious for future advancement, really possesses leadership ability. Most of the contributors this month support Jack and feel that he really would make a good foreman. The decision is not unanimous, however, as will be noted by the reading of the several contributions which follow.—EDITOR.

Nothing wrong with either "Jack" or "Corporal Smith"

TO THE EDITOR:

While doing myself the pleasure of reading the August number of the *Railway Mechanical Engineer,* I met with the article by "Corporal Smith" entitled "Was Jack Right?" I like this article. It reminds me of the one by "Bill Brown" on "The Foreman and His Responsibility" in which he advocated a humane, friendly and sympathetic way in managing men and in bringing along apprentices. His view was sharply criticized by "Top Sergeant" who championed the treating of men like "dumb driven cattle"—ruling them by brute force and bulldozing.

I noticed first the nice qualities of human nature in Corporal Smith and in Jack. Corporal Smith's keen sense of justice and propriety prompted him to raise the pay of Jack because of his outstanding ability and skill; and Jack who seems to be an altogether fine young man, refused the raise because of the ill feeling it would arouse in his fellow workman against himself and others, and because, like Lindbergh, he was not mercenary, but was, like Lindbergh, wholly devoted to advancement in his profession or calling. He was unwilling to introduce into the shop the shadow of discord through his acceptance of a raise, and would, therefore, give up a present for the sake of a future good.

It seems strange, and it must have been because of his genial character, that his extra ability did not excite, as is usually the case, the envy and ill-will of the other men.

Jack frankly told his superior what his aim and ambition was, and we would beseech Corporal Smith not to remove him from the line of promotion because he refused a raise in pay, or to think of him as Mark Antony did of Caesar that "ambition should be made of sterner stuff."

Jack's remarks to Corporal Smith show that he has given much attention to the modern methods of handling men, and I think his remarks express exactly the sentiments of Corporal Smith himself. You will recall he said:

"Well, Mr. Smith, I don't wish to get into any argument with you on handling men, but I think methods have changed greatly during the last few years. Yes, I may as well say it, since the craftsmen's strike of 1922, and perhaps in view of this, I am not so much mistaken in being concerned with what my associate workmen think of me. We are now striving to establish close, intimate relationships among ourselves and our foremen, and picking one out of a whole department for a higher rate will not help it along."

Some day in the not too distant future, when Jack has been promoted to a foremanship through the influence of Corporal Smith, I hope he may be seen presiding over a department, the men of which are thoroughly devoted to him, which means that they are doing their best in the matter of production. As a foreman, Jack's extra mechanical ability will enable him to give his workmen useful hints, though he would have to exercise great tact in doing this, for many workmen resent anything in the way of instruction by the foreman. Jack would have to follow the advice of Alexander Pope, who says:

> "Men must be taught as though we taught
> them not,
> And things unknown proposed as things
> forgot."

In conclusion, I think the reasons which Jack gave for refusing the raise in pay were good and satisfactory, and, assuming that he possesses the rare faculty of leadership, I think from his own words that he is good material out of which to make a foreman.

RAILROAD MAN.

Seem to be "bugs" somewhere

CHICAGO, Ill.

TO THE EDITOR:

A bare statement of facts such as contained in the August issue does not, in my opinion, justify the formation of an opinion on these facts, *per se,* any more than an opinion of any weight could be formed on the value or economy of roller bearing passenger equipment by the performance of the first unit ever equipped over the first ten miles it ran. The factors necessary for an intelligent judgment of its merits could not have been developed in that time. It is true that if it was successful to that extent it would be a factor in its favor, just as trouble would have been a factor against it, provided the factor is the result of fault in the bearing.

No supervising officer ever was or ever will be born or created full and perfect. No man becomes a re success but has some "bugs" in his makeup. The reason for his success is not that he has had no "bugs" in his character, but rather stands out as an evidence of his success as a "bug" hunter.

Given open-mindedness, intelligence, loyalty, reasonable courage and a decent belief in the essential practical soundness of telling the truth *with tact,* a man may be said to have the general characteristics essential to foreman material. A supervisor must learn to study the individuals under him with a view to making the most

of them and for them; part of his job, if he expects to attain to a higher one, is to leave the most important of them in his place so that when he branches off to the bigger job, the old one will not suffer for his having gone.

It would seem, then, that while the incident of Jack referred to may have been a mistake, it is quite possible that the "bug" may not be so serious but what it can be removed, and there is always a possibility that it may not have been a bug.

On the other hand, there appears to be every reason to believe that his foreman has a few of those little animals himself. What is he doing about trying to remove the bug? The whole procedure shows lack of study on his part, lack of knowledge of his men, or at least one of them. It would indicate that if he were to have to recommend a successor for himself he would not of necessity be in possession of the most important factor of their qualifications—their thoughts and principles.

I can imagine that our old friend "Top Sergeant" in a case of this sort would have eliminated one possibility for foremanship in a choice collection of asterisks and dashes, and "Bill Brown" on the other hand might have found some elements of interest and originality in the incident. And altruism before you have made your pile certainly is original, if indiscreet.

While I have never seen fit to refuse a raise, I am

JACK TOO.

Jack looked ahead

CLEVELAND, Ohio.

TO THE EDITOR:

The question is this: "Is Jack poor foreman material and should he have accepted the increase offered him?" This is a two-part question. Possibly for the sake of clarity, the additional question "Is the foreman right?" should be asked.

Assuming that this is a part of the question, my opinion would be (a) that Jack is probably good foreman material; (b) that it would be immaterial whether or not he accepted the increase, and (c) that the foreman was wrong and is not qualified to supervise men. My arguments follow.

(a) Jack is good foreman material, first, because his mechanical ability is first-class. Therefore he would be qualified in a mechanical way to train and supervise employees working under him. Second, he is not a shirker. In case he was made a supervisor the men would always remember that Jack was a fast worker and a good worker and they would not object to any urge for production from Jack, as they might from some foreman who, perhaps, did not always "hit the ball." Third, Jack has the ability to understand the problems of his fellow men. Witness his popularity. However, this is not so strange as "Corporal Smith" may think. The average first-class mechanic is usually popular with his fellow workers.

We must take into consideration in connection with this the (b) division of the question. So far as Jack personally is concerned, he probably would retain his popularity with most of the men even with the increase. However, Jack is far-seeing enough to realize that a rate like this would promote discord and dissension in the shop. Jack is more than likely a leader of the men and he can foresee that some of the men might possibly question his leadership. A good leader always sees far enough ahead to know what is around the next bend in the road. Jack, through his ability as a mechanic, his record as a non-shirker, and his undoubted qualities as a leader is certainly qualified to be a foreman.

To get to division (c) of the question. The foreman was wrong, inasmuch as he was not broadminded enough to give consideration to these factors. He was not qualified to handle a shop for the reason that he deliberately thought out a scheme whereby dissension might be, and probably would be, created in his shop. Surely other methods could be found to show appreciation of Jack's ability. The fact that Jack was interested in other things besides the dollar sign forever condemned him in the eyes of this misguided fellow.

H. R. RICE.

Jack's decision "preposterous"

NEW HAVEN, Connecticut.

TO THE EDITOR:

It would appear to me that Jack has a radical state of mind. This man is working in a railroad shop and no doubt he has to work for a living. If he refuses to allow the management to reward him for his excellent services, in the form of a raise in pay, for the sole reason that it might hurt the feelings of his fellow workmen, I consider him unable to hold a supervisory position. If he was made a foreman he would have a tendency to allow his own personal opinions to interfere with instructions issued by his superiors. The men working under him would be aware of this fact and would take advantage of him at every opportunity. He would be considered an "easy mark" by his fellow workmen, because any progressive workman would not do as he did. It is against human nature to take such a stand. I hardly think that any railroad executive would consider this man as a supervisor.

Jack states that if he accepted the raise it would cause dissatisfaction among the other men in the shop. I do not agree with him on this point. If the standard rate of pay for the men in the shop is seventy-five cents an hour and one man is raised to eighty cents, is it not natural that the other men are going to work for that raise? I, myself, would say that if Jack can get a raise so can I. I would show my foreman that I was just as capable and efficient and was also entitled to a raise. It is my opinion that ninety-nine per cent of the men in any shop would take the same attitude. It is a known fact that in any shop there are a few "sore heads" such as Jack referred to.

It is true that all railroads are striving to establish a closer relationship between the men and the supervisors and I consider that it is a wise move for any company to show their appreciation to a man by increasing his pay. This acts as an incentive to the other men and gives them a goal to strive for. Competition is what makes this world advance. Destroy competition and the world will stand still. I am sure that Jack did not take these things into consideration when he refused the raise. Anyone can readily see that Jack would not make a success as a supervisor because his ideas are too much to the extreme.

Jack should have realized that he was doing more work than the rest of the gang and was entitled to a little more compensation, in case the company decided to increase the pay of any of the men. There are a lot of men who do not know how much work they actually can do. This has been proven by the piece-work and bonus systems established on some of the roads. I have heard some men say that it was impossible to do a certain operation in a specified time. These same men, a month or two later, would be doing this operation in less than the time specified. This was brought about by the mere fact that the next fellow was "doing it." Competition is the greatest factor in the progress of any corporation. I believe that Jack sacrificed his fel-

low workmen as well as himself. When he refused the raise, he destroyed a chance to allow his fellow workmen to get into the competitive mood. Eventually there would have been others in the gang getting the raise the same as Jack if he had accepted the raise.

It is my opinion that Jack's foreman offered him the raise in order to stimulate the interest in the rest of the gang and see just how many men could equal, or even better, Jack's work.

If Jack is married I would like to know what his family thought of his decision. They must have thought the same as I did, that it was preposterous.

James McDonnell.

Jack has leadership ability

To the editor:

I do not agree that Jack was poor material for a foreman.

First, he indicated that he was a diligent worker by his application to his work which, as a general rule, indicates ambition—a man who applies himself and does more than his fellow-worker is surely striving to get ahead.

Second, the fact that he considered the morale of the remainder of the men to such an extent that he was willing to forfeit an increase, indicated that he had the company's interest at heart even more so than his own. The fact that he considered the effect on his fellow workers of an increase to himself, indicated that he had executive ability and not that he was afraid of his fellow men, and also that he was a student of men as we all have more or less socialistic ideas even though we try to conceal them. He probably figured out that the men alongside of him were putting as much effort into their work as he was, while maybe not accomplishing as much and that it would not be good business policy to differentiate the rates and put a premium of five cents an hour on one man's ability over another while at the same time both were making the same effort.

I have taken this line of reasoning on the assumption that the foreman was on his job and saw to it that each man was putting forth the proper effort.

"Statistician."

A.R.A. Rule 66—An opinion

New Haven, Conn.

To the editor:

An opinion was expressed in the August issue of the *Railway Mechanical Engineer* by J. B. Searles relative to the application of A.R.A. Rule 66. I do not agree with Mr. Searles in respect to holding the repairing line responsible for the box packing operation for the full 12 months. It is true that the car owner should have some protection, but I think that 60 days would be sufficient.

It would be unfair to hold the repairing line to the period of time suggested by Mr. Searles. It must be taken into consideration that the journal boxes are more or less disturbed at various times when the wheels are changed, and boxes, bearings and waste are renewed, to say nothing of the constant knifing of boxes in transportation yards.

The rule should provide that new waste be used when performing this work on foreign cars. Reclaimed waste at its best is not always fit to use in packing boxes.

The men selected to do this work should be experienced and competent as it requires men with good car knowledge and judgment or the work will not be performed as required by the rules. If more attention were paid to loose or missing box lids, the waste in the box would stay clean and lubricate more efficiently. I should think that these requirements should be incorporated in Rule 66.

James McConnell.

Another comment on substituting cast steel yokes

Greenville, Pa.

To the editor:

It seems to me that the editor's comment on Mr. Elder's letter in the July issue is likely to result in someone applying cast steel yokes in place of A. R. A. standard, in full confidence that they have a right to do so. For that reason I am referring to a few rules of the Interchange Code which may enable you to change your mind.

Rule 122 requires the repairing road to provide A. R. A. standard material. Rule 88 cannot be applied in any way to substitution of non A. R. A. standard material, for line 6 of Rule 88 specifically exempts the material referred to in the last paragraph of Rule 122. Rule 87 specifically refers to material which should be kept in stock by a repairing road and the defect card should be for both labor and material.

A. M. Orr.

Shock absorption qualities of arch bar trucks

Berlin, Conn.

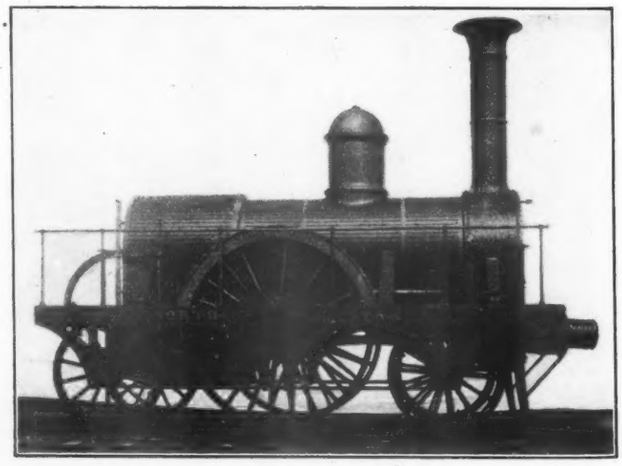
To the editor:

After reading the report of the Mechanical Division, A.R.A. Committee on Car Construction, in the July issue of the *Railway Mechanical Engineer*, some questions were raised in my mind concerning the truck frames on freight equipment. I am wondering if some reader can answer the following questions:

Will an arch bar truck absorb more shock than a truck with cast steel side frames?

Will such absorption of shock, if there is any, prolong the life of the car underframe and body to any great extent?

Clayton F. Crosson.

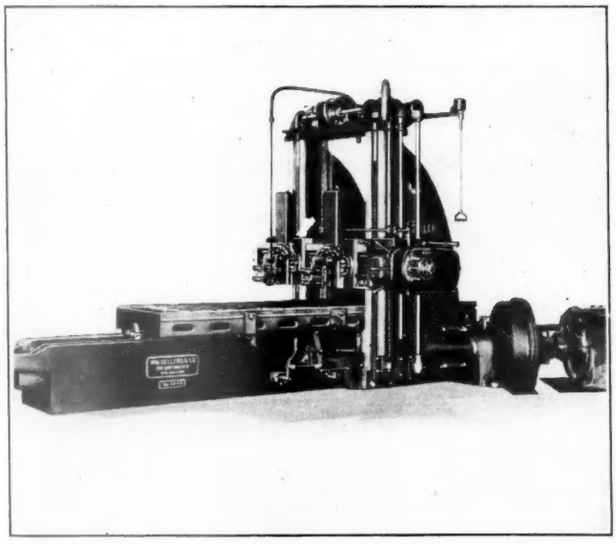


The Great Western of England's "North Star" locomotive which was exhibited at the centenary exhibition of the Baltimore & Ohio

Redesigned 36-in. by 36-in. Sellers planer

THE redesigned 36-in. by 36-in. planer recently placed on the market by the William Sellers Company, Inc., 1600 Hamilton Street, Philadelphia, Pa., combines the basic principles of all the Sellers planers with modern improvements such as the power traverse, dial feed, central lubrication, single lever crosshead locking device, etc. The machine is designed with simple and substantial mechanism and readily accessible parts.

The bed is of the box type construction with one flat



The Sellers 36-in. by 36-in. by 8-ft. Type K planer provided with push button control

and one double vee way. The double vee feature is for the purpose of accuracy under the heaviest kind of side cuts. It consists of a flat vee combined with a vee with the walls inclined a very few degrees from the vertical. The bearing is on the flat vee except in cases of excessive side pressure when the upper vee will hold the table from moving out of place. When there is no side thrust, the upper vee clears by a few thousandths of an inch.

The drive is by a reversing motor located on the right side of the machine towards the rear and well out of the way of the operator. The motor is mounted on a separate base plate and coupled to the pinion shaft. There is one reduction between the motor and the main driving shaft which carries the spiral pinion. This reduction consists of a steel herringbone gear and pinion running in oil. The spiral pinion is so designed that four teeth are always in contact and the angle of the rack is so arranged that no side pressure is developed from the pinion. The thrust from the spiral pinion is taken on step bearings from the outside of the bed where they are readily accessible. Oil is continually circulating through the thrust bearings.

The table is of deep box construction and provided with tee slots and stop holes. It is open at the side for the removal of chips. The rack is separate from the table and made in sections and fastened to the table by clamps. One end of the rack abuts against a solid stop on the table and the other end is held by a heavy steel clamp. This method of holding the rack prevents the distorting tendencies of bolts or dowels placed through the rack itself.

The ways are furnished with an ample supply of oil from a pump driven by a separate motor. The control for this motor is so connected into the driving motor circuit that the pump will always be running before the table starts. This insures lubrication even after standing idle for some time. The pressure of the oil is constant and sufficient to force it through the grooves for the full length of the table. The oil is collected at the ends of the bed and is filtered before being returned to the tank.

The cross rail is of the extended back type. It is of box construction between the uprights, and is clamped by a single lever operated through a powerful mechanism. The clamp is so designed that it fastens the cross rail to the uprights and at the same time holds the uprights together at a point as close to the work as possible. The cross rail in this way acts as an extra crossgirt located at a minimum distance above the work.

The machine is usually equipped with two heads on the cross rail and a side head on each upright. The saddles, slides, etc., have been entirely redesigned, improving and strengthening them wherever possible. Power traverse is provided for all heads.

The design of the feed and traverse mechanism is simple and rugged. Selective levers for the various motions are conveniently located. One head can be traversed while another is feeding. The movement of only one lever will throw from feed to traverse. The screws

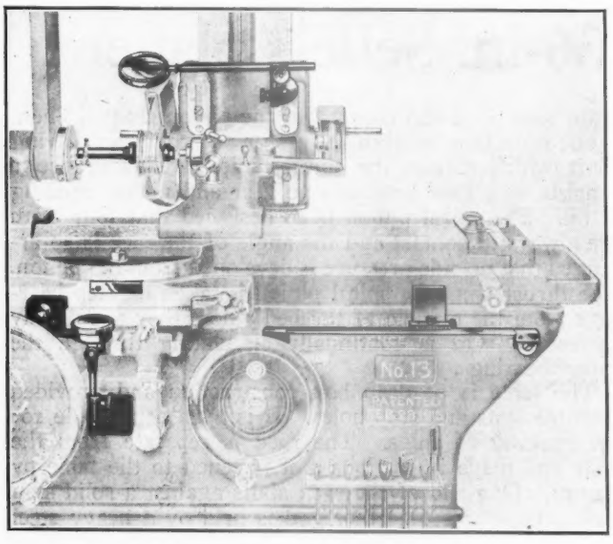
and shafts are provided with micrometer dials for setting the heads accurately. Central unit lubrication is provided, thus simplifying the work of the operator in oiling. The feed is accomplished by a separate motor. A dial on the cross rail and on each side head is used to set the amount of feed. Ball bearings are provided wherever advisable.

The saddle castings are made of heavy section and provided with taper gibs. The tool slide is of the outside type. With this design of slide, the bearing between the slide and the swivel which carries it, remains constant for short or long overhang. A spring compensating device takes all lost motion from the vertical screw and nut and prevents the slide from dropping at the end of the stroke. The side heads are counterweighted to the full amount.

An adjustable speed reversing planer motor is provided for driving the table. Auxiliary motors furnish the power for feed and traverse of heads and lift of the cross rail. A ½-hp. motor drives the pump for lubricating the ways. The control equipment is of the magnetic type and operated by push buttons or switches.

Circular forming tool grinding equipment

THE contours of screw machine forming tools and work of a similar nature can be ground to advantage with the equipment recently developed by the Brown & Sharpe Manufacturing Company, Providence, R. I., for use on its No. 13 universal and tool grinding machine. This equipment, designated as the circular forming tool grinding equipment, can be readily applied to the machine and is furnished either as a complete equipment or in separate units.



The circular forming tool grinding equipment applied to the Brown & Sharpe No. 13 universal tool grinder

The equipment is advantageous when extreme accuracy in the duplication of forms is desired—especially in high speed steel where turning is difficult. Greater accuracy of the form assures longer life of the tool and provides a more exact and satisfactory product.

Floating work arbors hold the work in position between centers and a radius truing device and magnifying glass provide for accurately truing the grinding wheel to the correct form. A dial indicator mounted in a bracket secured to the bed permits a very accurate reading of the table movement, as the point on the indicator engages with a stop secured to the sliding table dog rack.

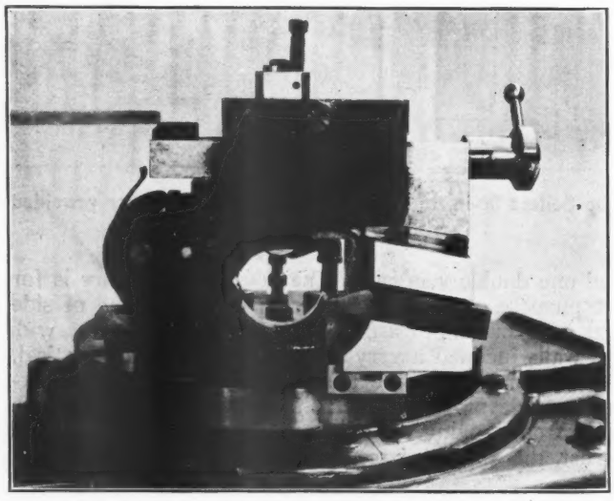
A scale to the right of the cross feed handwheel is designed to give an accurate vernier reading on long work beyond the capacity of the dial indicator. The vernier is secured to the sliding table. Fine angular adjustments of the upright are facilitated by a vernier located on the cross feed carriage at the rear of the machine. When grinding angles, the swivel table vernier provides for additional adjustments.

Taper turner for use on turret lathes

THE Model M taper turner recently placed on the market by the Jones & Lamson Machine Company, Springfield, Vt., is a departure from former designs in that it is designed to be used in two ways: first, in turning tapers from the rough bar, in which case the cutter precedes the rolls; and, second, in turning tapers from finished stock or where the bar is first turned straight, in which case the rolls precede the cutter and bear upon the surface previously finished.

The template is the same size and shape as has been used on the Model K taper turner. It is made about two in. longer than the length of the cut, so that the end can be pointed to make it enter easily. The angle of taper on the template is exactly one-half the included angle of the taper on the work.

As illustrated, the turner is set up to turn tapers from the rough bar, and the rolls follow the cutter. For this work a cutter of one-inch square stock is used. The cutting point should protrude about 1 1-16 in. from the cutter slide, and is just high enough to be at the center of the work. On new lathes, this will be 3 in. above the top face of the turret on the 2¼ in. by 24 in.,



Model M taper turner for use on Jones & Lamson turret lathes

and 4 in. above the turret on the 3-in. by 36-in., and 4-in. by 34-in. machines. The cutter can be adjusted for height by the screw directly under it. After the cutter is placed, it is necessary to adjust the rolls to it. The rolls are made with one edge slightly chamfered and the other edge ground to a ⅛-in. radius. For very shallow tapers—1-16 in. to ⅛ in. taper per foot—the sharp corner of the roll is next to the cutter, but when turning steeper tapers the round corner is used.

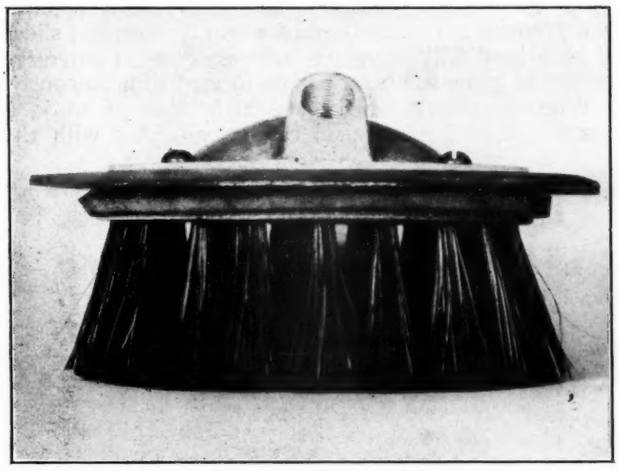
In adjusting the rolls, it is necessary first to turn a short taper on the bar, preferably close to the chuck, and then adjust the rolls to it, so that the contact is just enough to turn the rolls when the work is revolved. The adjustment for the rear roll is obtained by turning the screw against which the upper arm of the rocker arm bears. The adjustment of the upper roll is obtained by turning the screw directly under the size-adjusting knob. Adjusting this screw moves the wedge against which the wedge on the upper roll holder bears.

When using the turner for cutting tapers with the rolls preceding the cutter, it is necessary to use a cutter made of ½-in. by 1-in. steel. The rocking lever which controls the rear roll is moved forward so that its upper end bears against the screw which is in front. By turning this screw, the roll is adjusted and held to the proper position. To adjust the upper roll, the adjusting screw at the right is turned out about 1¼ in. This allows the wedge inside to move out of the way of the roll slide, and the roll is then adjusted and held in proper position by the overhead adjusting screw.

A refillable car cleaning brush

A NEW type of refillable window cleaning brush which is a combined brush and sprayer has been placed on the market by the Specialty Manufacturing Company, Berea Road, Cleveland, Ohio. The brush was designed to meet the needs of railroad, bus and street car companies for washing car windows and other parts not readily accessible from the ground. The type illustrated is in use on several of the Eastern railroads. The bristles, which are cut to a level cleaning surface, are set into an aluminum plate or block. Between this and the aluminum back plate to which the handle is attached, is a hollow space, packed watertight by a rubber gasket. A length of pipe attached to a hose is screwed into the threaded opening provided in the back plate, and the water is forced through a number of fine holes in the front plate. In this way, cleaning is greatly speeded up as compared with the old method of wiping, especially where the part to be cleaned is not easily accessible. This is desirable where many passenger cars are cleaned daily.

The edges of the gasket project well beyond the edges of the aluminum water-chamber so that the metal itself cannot hit the surface being cleaned. The brush may be easily shifted around on the handle so as to wear all bristles equally. When completely worn out, the brush may be returned to the factory for refilling.



A car washing brush that combines the functions of a spray and a cleaning brush

The Bullard Contin-U-Matic center lathe

THE Bullard Machine Tool Company, Bridgeport, Conn., has recently placed on the market an automatic multiple spindle production machine of the continuous unit type for the machining of work held between centers in a vertical position. The basic principle in the machine is similar to the six spindle Contin-U-Matic chucking machine with six work spindles in a carrier and six tool heads mounted on a hexagonal tool column built integral with the carrier, the respective spindles and tool heads always remaining in direct relation to each other and forming six individual units which in operation are rotated slowly around the central column. One complete cycle is required for the chucking, machining and unloading of a single piece, but six units operating simultaneously produce six pieces during the cycle time.

In the Contin-U-Matic center lathe a tail stock and center is mounted on the upper portion of the tool support column and may be varied in height to suit the length of the work between centers. The maximum capacity is approximately 20 in. on the standard machine but may be increased when the occasion requires by an extended height of the tool support column and other parts where these special features are justified.

Spindle speeds available include a complete range up to a maximum of 300 r.p.m. and may be obtained by change gears in the drive bracket. Any one set speed is common to all spindles.

In diameter of work, the machine has a maximum capacity of 9¼ in. swing under the tool slides and 5¼ in. maximum diameter clearance between the tool slides.

All of the tool heads are actuated by a vertical motion from the common cam mounted at the head of the machine which provides for a rapid advance of the heads to the point of cutting. A period of feed at a predetermined set rate and a rapid return with a short dwell at the high point permit the unloading and chucking of work. Primary feed motion from this cam is transmitted through secondary speed boxes mounted on the face of the tool support column to two tool slides at either side of the center which are independent in action and independently variable in rate and length of feed

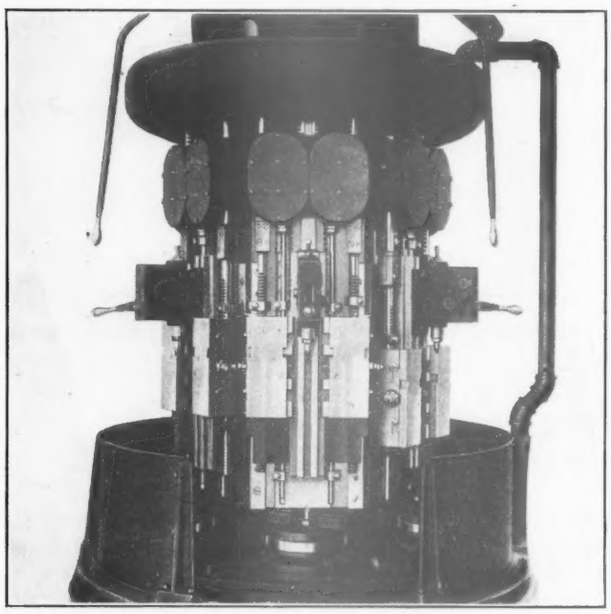
stroke by the relation of the gears in secondary feed boxes on the face of the column.

Tool slide traverse provides for exceptional adaptability in vertical and horizontal cuts. Each slide may be independently set for either plain vertical or plain horizontal stroke with rapid advance and feed of predetermined rate and length. In combined motion, however, each slide will advance horizontally to the work, traverse vertically along the cut, withdraw from the work at the bottom of the stroke and return in rapid motion to its original position.

The maximum length of plain vertical stroke is somewhat over 9 in. and the maximum horizontal stroke is 1¾ in. In combined horizontal and vertical traverse the compounding requires 3.66 in. of vertical rod motion per 1 in. of horizontal traverse. By deducting the amount of vertical motion necessary for the horizontal traverse required, the balance of the maximum 9-in. stroke is available for the direct vertical feed of the slide. The slower horizontal tool feed is of advantage when the tool is nosing its depth into the work, but vertical feed along the cut is taken at the standard set rate.

This arrangement of tool slides in each head provides for a considerable variety of independent tool application grouped in each unit and the two independent slides of each head will, therefore, accommodate an extensive variety of grouped operations performed simultaneously.

When necessary for the special holding of work, a power operated mechanism can be provided with the

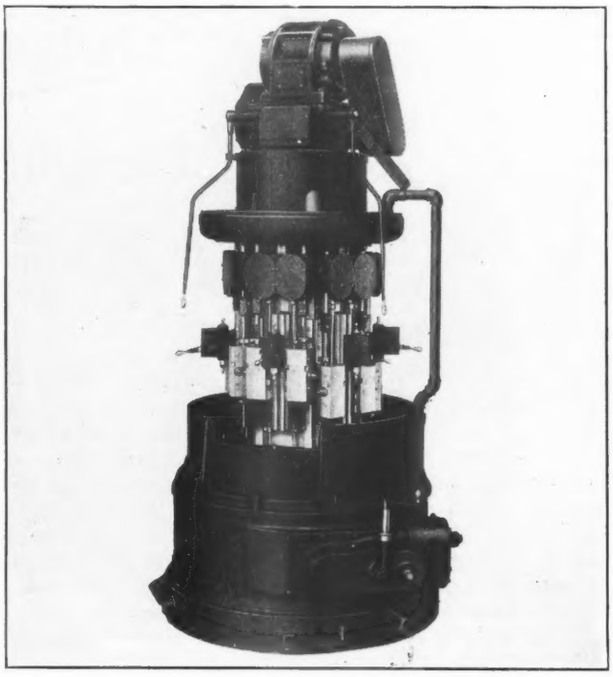


The tail stock and center are mounted in the upper portion of the tool support column

machine for actuating the chuck or special work holding fixtures. A unique design of tail stock operated with one motion of the hand lever facilitates the holding of the ordinary run of work between centers.

In the operation of the machine the cycle is divided into two sectors; a loading sector occupied by the rapid return high dwell and rapid advance of the tool heads during which time the spindle is not in revolution and the finished piece may be unloaded and the rough piece chucked. The machining sector occupies the greater part of the cycle during which the work spindles revolve and the cutting operations are in process. The cycle time for various classes of work can be varied from one minute up to fifteen minutes, as required and the rates of tool feed may be set within a considerable range and directly applicable to the job. Independent tooling on the six individual units which comprise the machine make it possible to vary the operation and even the nature of the work in process, running a variety of jobs at the same time providing only that the common features of spindle speed and primary tool head traverse are adaptable to all operations as a class.

In operation, the machine can be completely controlled from one position while the main drive clutch levers are



The Bullard Contin-U-Matic center lathe

provided at three different points about the cycle. Control of the carrier motion is through a lever located to the right of the loading sector and this lever through an independent clutch and back shaft engages power for either forward or reverse movement of the carrier. Provision is also made for hand movement when necessary.

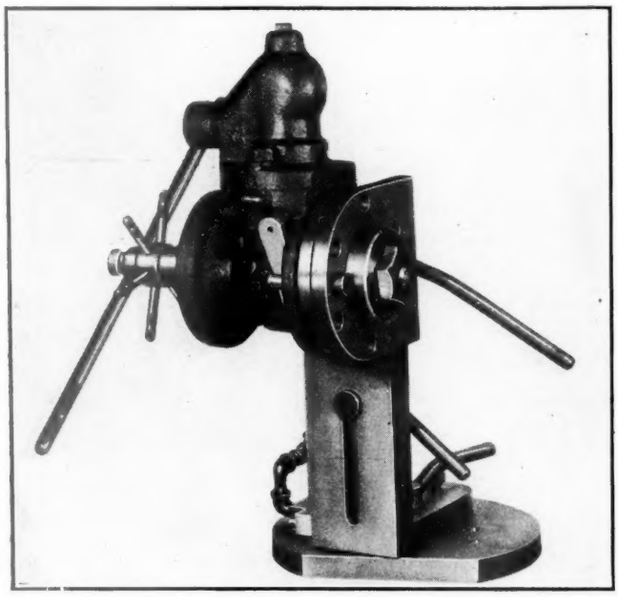
Power requirements of the machine will range from 10 to 20 hp. and facilities are provided for motor drive with sprocket and chain connection to the main drive shaft. A constant speed motor running at 1,200 r.p.m. with either a.c. or d.c. current may be used.

ELECTRIC HEATERS FOR RAILWAY CARS.—The Gold Car Heating & Lighting Company, 220 Thirty-sixth street, Brooklyn, N. Y., describes its study and research on enclosed types of heating elements in its 64-page catalogue on the subject of electric heating for railway cars. Electric heaters with both open coil and enclosed types of heating elements are embraced in this catalogue.

MORTON APPLIANCES.—The line of railway appliances and industrial steel products made by the Morton Manufacturing Company, Chicago, is illustrated in a concise yet comprehensive manner in a highly attractive 9½-in. by 11½-in. general insert catlogue recently issued. The various products include such items as safety treads, car doors, furnishings, flooring, buffing mechanisms, diaphragms, window curtains and fixtures, steel moldings, etc., all carefully indexed. The catalogue may be kept up to date by the insertion of new or revised sheets as issued and should prove of real assistance to those responsible for the selection of railway and car equipment.

Triple and distributing valve grinder

THE Sheldon Machine Company, 3253-55 Cottage Grove avenue, Chicago, has acquired manufacturing and selling rights on a complete line of patented equipment for grinding the worn cylinder bushings of triple and distributing valves. This equipment



View showing triple valve set-up

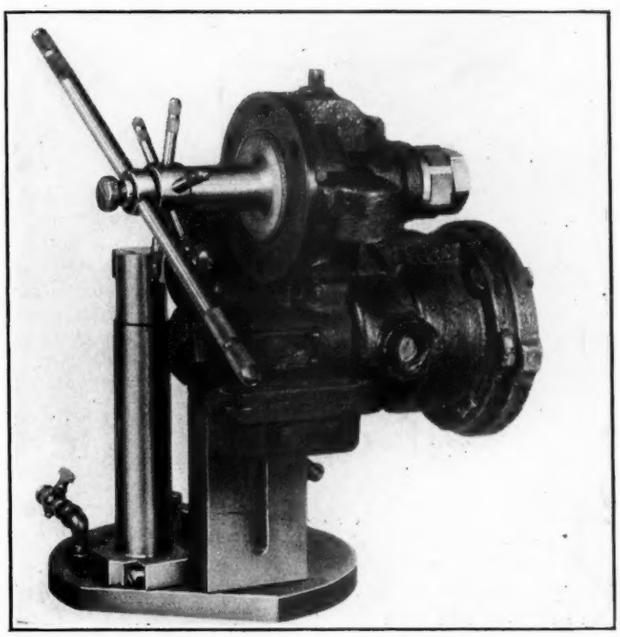
is simple in construction, easy to operate and designed to perform highly accurate work with a minimum enlargement of the worn cylinders, as may be readily understood by reference to the illustrations.

A suitable fixture, which holds the work in any convenient position for all repair operations usually performed on triple and distributing valves, is provided with quick clamping facilities and means for elevating the work by an air cylinder arrangement and swiveling either the work head or the base to any position.

The grinding tool consists of an expanding abrasive ring which operates on double opposed cones and is expanded by the action of a feed head. Accurate alinement of the tool assembly is controlled by a pilot which operates in sliding relation in a hardened and ground floating or adjustable guide sleeve.

The tool is used by placing it in the cylinder to be ground and expanding it firmly which fixes the centers. The floating guide sleeve is then securely locked in a fixed position by a lock nut. The grinding ring is released or collapsed slightly by the feed wheel to permit a turning and sliding movement, necessary for the grinding operation. While turning the operating handle, the pilot guides the tool and not the worn cylinder walls of the triple valve, thus preventing the grinding ring from following the worn hole in the bushing as the tool pilot is held in alinement by the guide sleeve. A removable steel cup or form is used for cementing the abrasive cloth on the grinding ring.

Owing to the simplicity of the Sheldon grinder it is



Sheldon grinder set-up for truing a worn distributing valve cylinder bushing

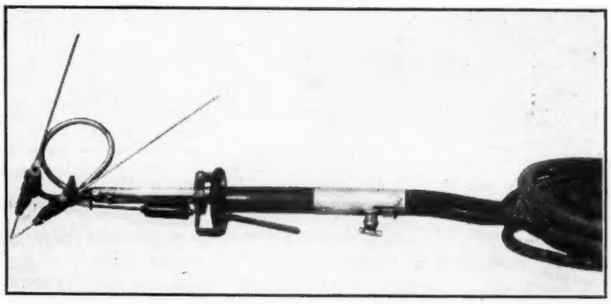
said any man who can properly fit a packing ring is capable of using the tool. It is recommended that cylinder bushings be trued every time a new packing ring is applied and this should be done until the cylinder bushing is enlarged to a point where it needs replacing.

Equipment for welding with atomic hydrogen

METHODS of producing a flame of atomic hydrogen and its probable use for welding was described on page 249 in the April, 1926, issue of the *Railway Mechanical Engineer*. The investigations leading up to the discovery were directed by Dr. Irving Longmuir of the General Electric research laboratory located at Schenectady, New York.

Since that time the process has been put to extended use in the shops of the company, notably in the production of its automatic refrigerator unit. This permitted the development of the equipment, which is now ready for sale.

In brief, this method utilizes the passage of a stream



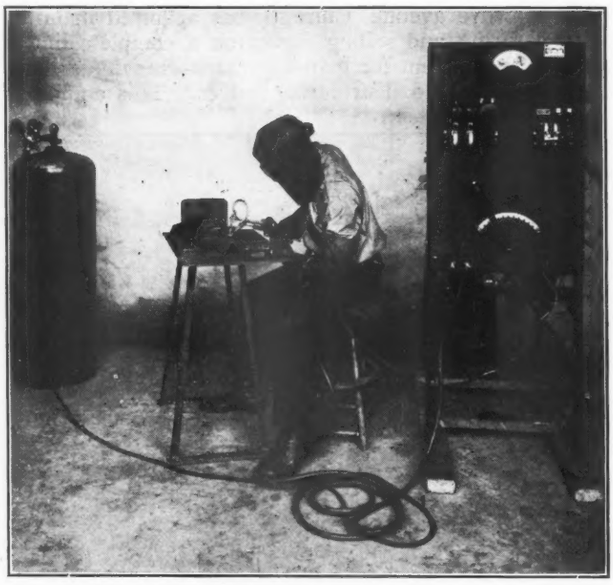
The atomic hydrogen welding torch for general use

of hydrogen through an arc struck between two metal electrodes. The heat of the arc breaks up the hydrogen molecules into atoms. A short distance beyond the arc these atoms recombine into molecules of the gas, and in so doing liberate a great amount of heat. This heat gives the jet of gas the appearance of a flame, and it is used exactly as an oxy-acetylene welding flame—that is to say, it will melt without oxidation the abutting edges of any metals, and reinforced joints may be made by the addition of suitable welding rods.

The welding outfit consists of a single-phase transformer for converting 60-cycle single-phase power to the voltage suitable for the welding equipment, a specially designed, variable reactor to provide the proper welding current and voltage for different classes of work, the welding torch by means of which the actual work of welding is performed, a cylinder of hydrogen with pressure reducing regulator, and the necessary hose, cables, hood and electrodes.

The torch consists of a holder supporting two tungsten wire electrodes with the electric conductors, and the tubing and valve for hydrogen gas. Each electrode is supported inside a nozzle through which the gas is forced out around the electrode. The combination of electrodes and nozzles is set at an angle and the distance between electrodes, or arc length, is readily adjustable by pressure on the hand lever. When welding ceases, the circuit is automatically interrupted until such time as the operator is again ready, when the circuit is automatically restored. In contrast to the usual method of electric arc welding, there is no current flowing from the electrodes to the work to be welded; the circuit is completed from one electrode to the other and the heat transmitted to the work by the jet of gas.

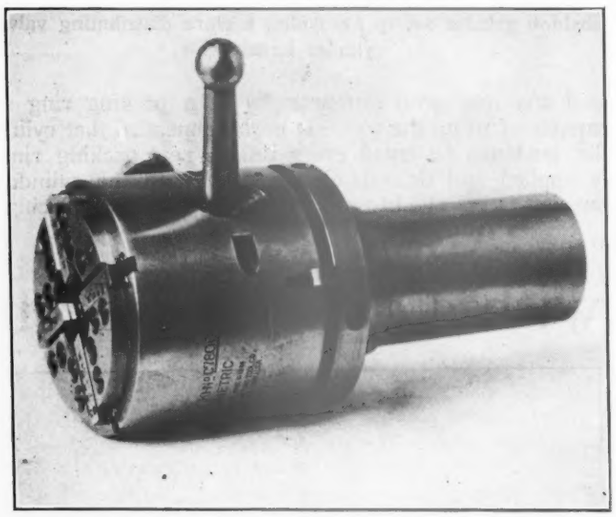
The new equipment is recommended for use on ordinary metals less than ¼-in. in thickness, or on hitherto unweldable metals of greater thickness.



Operator at work with the new welding equipment

Self opening die head with few parts

THE Geometric Tool Company, New Haven, Conn., has placed on the market a new line of stationary self opening die heads for use on hand screw machines, turret lathes, etc. This line of tools—designated as Style KH—takes the same type of chaser as does the Style K and KD head, thus offering chaser interchangeability covering a complete line of tools which within its line offers a tool readily adaptable to any type or make of machine. The tool is simple in design. The only screws in the tool are those in the front plates, and these should not be removed when disassembling the die head. No complicated mechanism is required to open or lock the tool. The die head is opened and closed axially, the opening action being accelerated by two straight springs in the skeleton. The locking mechanism consists of a pawl with a very broad surface of contact. The chasers are removed by pulling up the spring stop plunger, when the die head is in the open position, and then withdrawing the chasers with the fingers. The size adjustment is equally simple. A fraction of a turn of the adjusting ring on the back of the head, and the size is adjusted and locked in place by a spring pin.



The Style KH Geometric self-opening die head

The chasers are rigidly backed up directly behind the cutting point by a heavy closing sleeve with no intermediate parts to spring or wear. They are rigidly supported on both sides and bottom, with a supplementary support along the top by the front plates.

The tools are made of a special alloy steel. The Style KH die head is built in five sizes with a cutting range for straight threads from ⅛ in. to 3½ in. and Briggs standard pipe threads from ⅛ in. to 3 in.

NICKEL IN CAST IRON.—Outstanding improvements in alloy cast iron and its economic importance to the foundry man and machinist, are described in Bulletins Nos. 203 and 204 issued by the International Nickel Company, 67 Wall street, New York. Bulletin No. 203 gives a resumé of the general characteristics of commonly used nickel-bearing cast iron compositions with a number of typical mixtures and a discussion of the saving effected and the difficulties overcome by their substitution for ordinary cast iron. Bulletin No. 204 contains a non-technical explanation of the function of nickel in eliminating chilled edges from light castings and hard skin from heavier ones without impairing the physical properties as is the case when the common elements of cast iron are employed for this purpose.

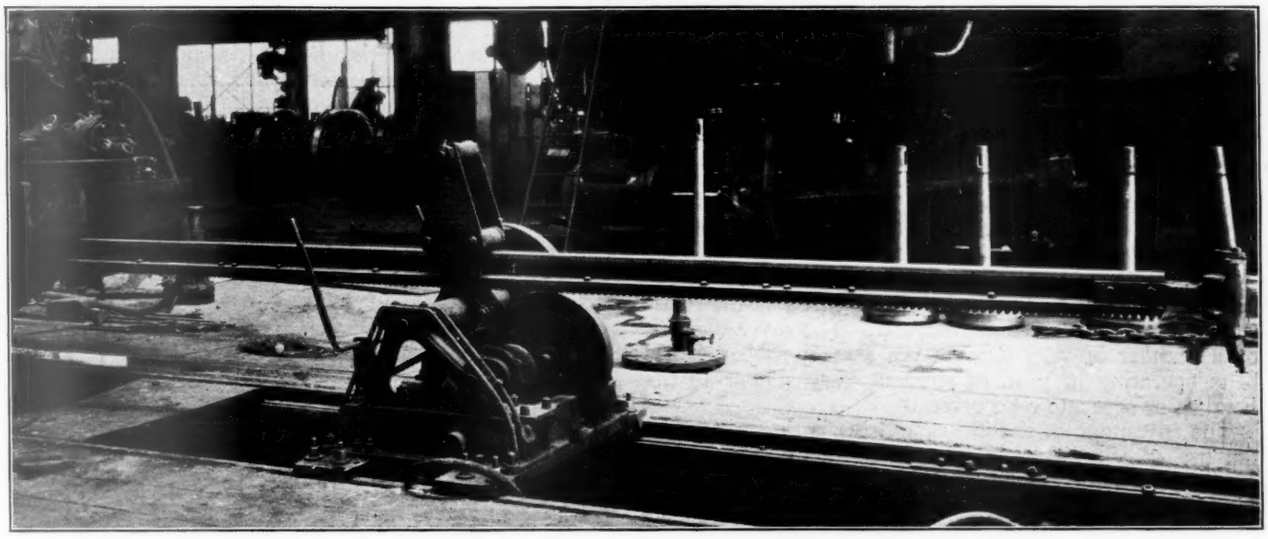
Power locomotive moving device

A PNEUMATICALLY-OPERATED locomotive moving device was designed by J. B. Irwin, shop superintendent of the Chicago, Burlington & Quincy, Denver, Colo., who has applied for a patent. Built in the Denver shops, it has been in service for three years, being used for several purposes, such as when applying main rods and trying travel, setting valves and moving locomotives for spring rigging changes. In some cases it is used for pushing engines out of the shop to be fired up.

Referring to the illustration, it will be observed that the device consists of a rail section coupled at one end to the locomotive and having a rack bolted to the flanges with teeth engaging in a pinion and gear arrangement driven by a six-horsepower Chicago pneumatic hoist motor. The device is firmly clamped to the pit rails in the proper position by means of four bolts and two clamping plates to each rail. The rail head bears against two rolls as indicated, holding it in fixed relation with the pinion center. Operation of the pneumatic motor suitably supplied with air pressure from the shop mains enables the rail and connected locomotive to be moved a given amount in either direction as desired. Owing to the large gear reduction, very fine adjustments of rail position may be secured which is an essential requirement for the work mentioned.

By using this device for valve setting, it is possible to apply all of the rods before the locomotive is put on its wheels, which is the method followed at Denver shops for squaring valves with all parts in their normal position. It also eliminates the necessity of using pinch bars and laborers for doing this work, as one machinist and a helper can apply to the main rods, try the travel and square the valves in a short time. It also eliminates the danger of personal injury which accompanies the use of pinch bars and other means of moving a locomotive.

The locomotive moving device will change the position of the heaviest locomotive and tender 20 ft. in either direction in about 1½ min. and movements as fine as 1/16 in. can be effected if desired.



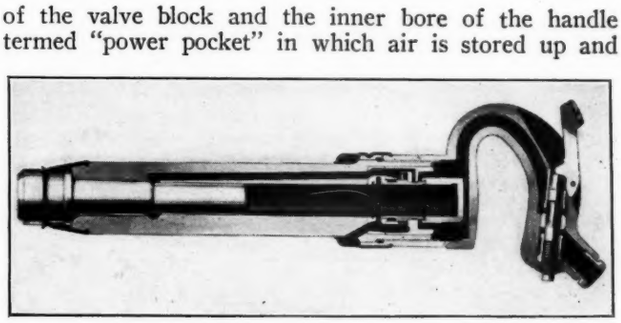
Air-operated locomotive moving device

Cleco pneumatic riveting hammer

THE main valve in the Cleco riveter, manufactured by the Cleveland Pneumatic Tool Company, Cleveland, Ohio, is tubular, through which the piston passes at each stroke. It is actuated by live air in both directions which insures a uniform and steady action. It is short, light in weight, has solid walls free from port holes and is re-enforced at the lower end as a protection against injury from piston slap.

Pistons of different lengths may be used without detriment to the tubular valve—the valve being short allows use of short pistons without danger, as the piston always has a reasonable bearing in both the cylinder and cushion chamber. A cushion chamber is provided in the rear end of the valve block integral with the block and in alinement with the valve and cylinder bore which insures a constant cushion for the piston on its return stroke, absorbing all shock or recoil.

An air reservoir is provided between the outer walls of the valve block and the inner bore of the handle termed "power pocket" in which air is stored up and discharged in volume on the piston at the beginning of each stroke, giving added impulse to the piston and increasing the speed and force of the blow.



The main valve walls of the riveter are free from port holes

The safety handle lock is designed safely to lock the handle onto the cylinder and is so constructed that easy and close adjustments may be made as the hammer becomes worn in service. It consists of a locking ring with teeth milled in the upper side to engage similar teeth milled in the lower edge of the handle and keyways cut on the inner side to engage similar keyways cut on the cylinder. A spring clip holds the ring and cylinder together and further provides an outlet for exhaust air. The clip can be turned to deflect the exhaust air away from the operator.

The balanced throttle valve is operated by a throttle lever so controlled that it allows a reasonable free action before engaging the throttle valve. The throttle valve operates within a steel sleeve seated in a recess provided in the handle, both of which are hardened and ground.

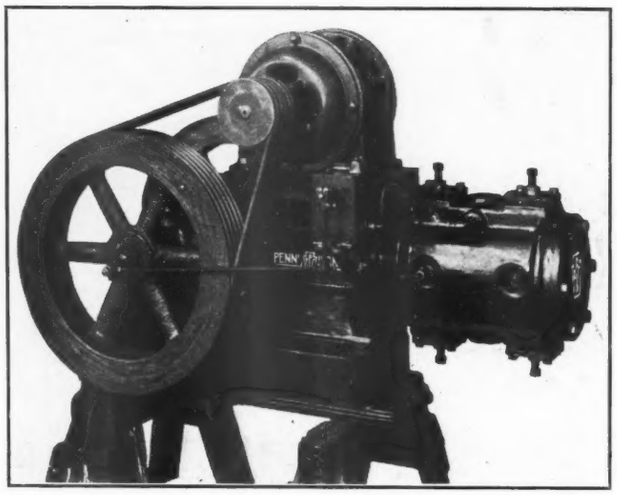
Air compressor fitted with the Texrope drive

THE Pennsylvania Pump & Compressor Company, Easton, Pa., has recently placed on the market a unique arrangement for driving horizontal double acting air compressors where floor space is limited. Heretofore, in a belt-driven unit, the closest spacing has been by the use of a short belt drive, where the motor is set ahead of the compressor, with an idler riding on top of the belt to provide the necessary tension and take-up.

Now the drive employed for these units is the multiple belt drive known as Texrope, manufactured by the Allis-Chalmers Manufacturing Company. The drive consists of a number of very flexible vee shaped rubber fabric belts operating in grooved sheaves, very similar to the English or separate rope drive.

The advantage of the Texrope drive is that it permits the use of very short centers, because of the absence of slipping due to the vee shape of the belt. This eliminates the used of an idler and the motor may, therefore, be set up immediately ahead of and in the closest proximity to the frame of the compressor. Where space is extremely limited, the motor may be mounted directly on top of the compressor frame. In this position the motor is accessible for repairs.

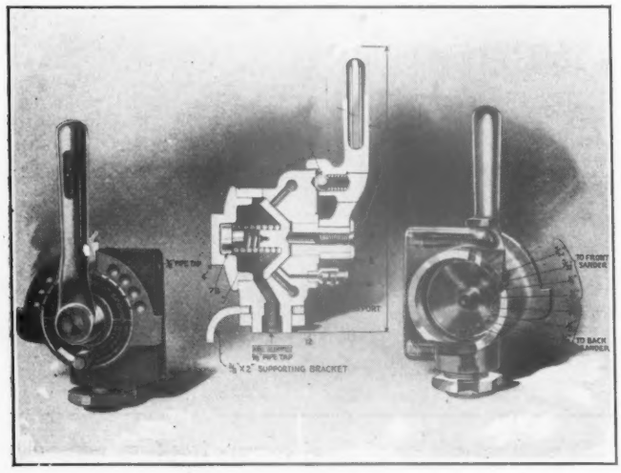
Either method of mounting makes a very neat arrangement, and in the overhead type, as shown in the illustration, no additional floor space is required for the motor.



The overhead type of Texrope drive for an air compressor

Viloco redesigned sanding equipment

THE Viloco Railway Equipment Company, 14 East Jackson boulevard, Chicago, has placed on the market a redesigned sanding equipment which is shown in the accompanying illustrations. The duplex engineman's valve with a warning attachment for operating the pneumatic sanders has four graduated positions, for both front and rear sander. The graduations are effected by ports of different diameters through the valve. The ports register with notches on the quadrant, enabling the engineman to apply the sander gradually to its full capacity. The air is admitted through the bottom of the valve, where provision is made for securing the valve to a supporting bracket attached to the boiler head.

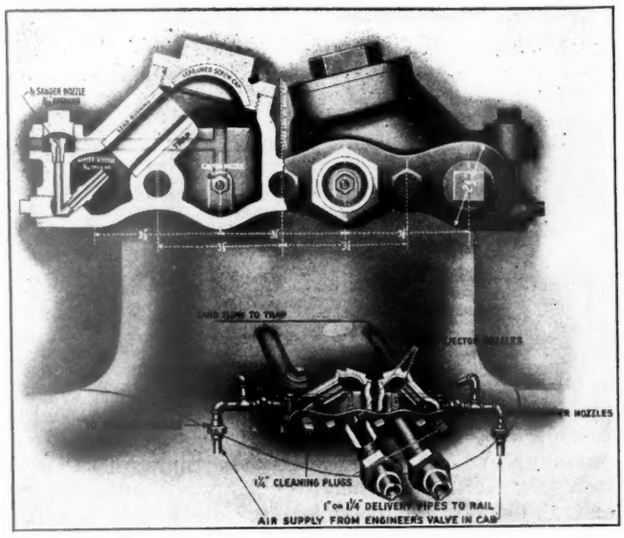


Viloco Type FL duplex enginemans valve, with a warning attachment, for operating pneumatic sanders

The warning attachment operates as soon as the handle is moved off the center notch of the quadrant and serves as a warning to the engineman that the sander is in operation. The warning port can be closed by a slight pressure on the warning valve, but as soon as this pressure is removed, the warning reminds the engineman instantly that the sander is in operation.

The improvement in the sander consists of locating the sand ejector nozzles within the trap, opposite the upper ends of the two delivery pipes, insuring forceful delivery of sand through the delivery pipes to the point of contact between the driving wheels and the rail, which feature likewise provides a means for cleaning out the delivery pipes should they have a tendency to become clogged. To prevent the sander nozzles from becoming inoperative, the nozzles are located above the sand level

in the trap. Lifter nozzles have also been provided to regulate the amount of sand delivered.

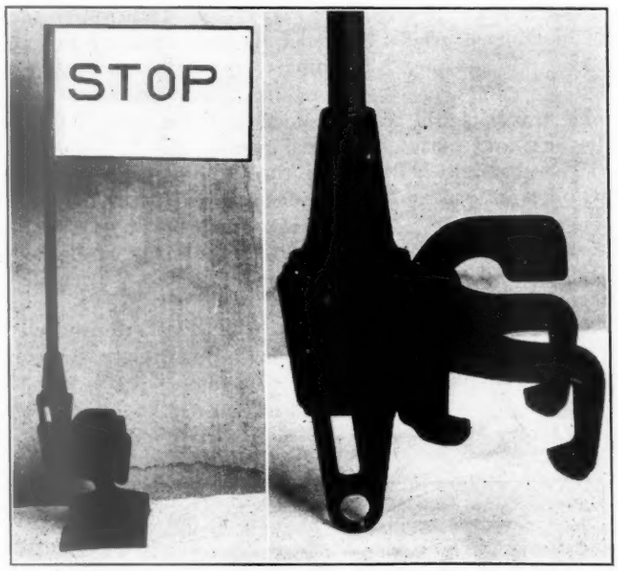


The Viloco Style FL-312 double sander with four delivery pipes

The sanders are furnished single, double, triple and quadruple for any sanding arrangement desired.

Safety flag holder

A SAFETY flag holder, known as the Lion-Grip signal holder, and designed to hold a blue flag as a protection to workmen on repair tracks at isolated cars, in enginehouse stalls, etc., has been developed and is being manufactured and marketed by the



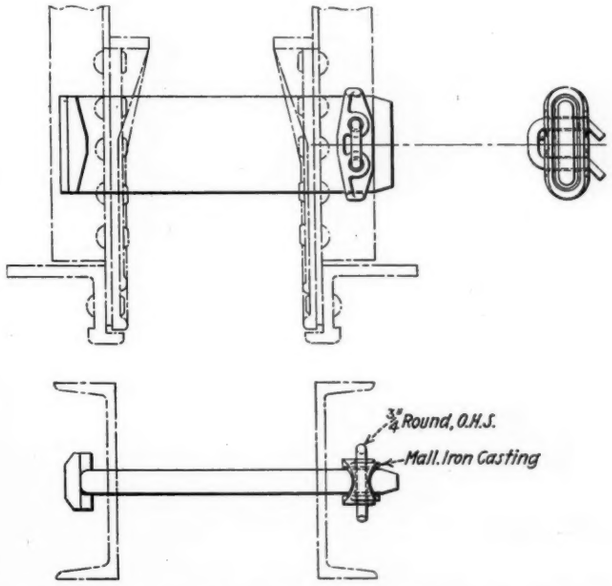
Safety flag holder notable for light weight and easy application to and removal from rails

Danville Malleable Iron Company, Danville, Ill. This device, attachable to the rail as illustrated, is made of malleable iron parts subject to little wear and requiring no adjustment in setting up or taking down the safety flag holder.

The holder is designed to be positive in action, durable and light in weight. It is self-adjusting to any size of rail and holds the signal in a firm, upright position at right angles to the track. In operation, simply placing the holder on the rail automatically clamps it in place. An upward lift automatically releases it. When necessary, a switch lock applied in the bottom hole locks the flag holder to the rail. The construction is such that the flag or signal attached to the staff cannot be turned, accidentally or otherwise, parallel to the track so as not to be seen by the crew of an approaching locomotive or other piece of moving equipment.

Malleable iron draft key washer

THE illustration shows the application of a draft key washer recently developed by the Pressed Steel Car Company, Pittsburgh, Pa. This device consists of a malleable iron washer or wearing piece applied to the tapered end of the draft key. This washer is so designed that any thrust or pressure coming on the washer, due to the shifting of the key, will come at the center of the washer regardless of the angularity or position of the key in the slot. Where a U-bolt type of cotter is used for holding the washer in place the design has the effect of producing shear on both legs of the cot-



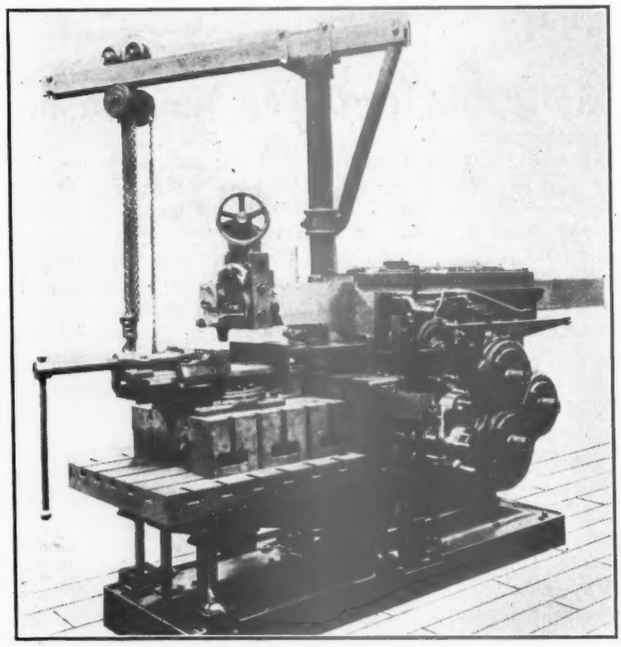
Application of the malleable draft key washer with a U-type cotter pin

at the same time, thus increasing the effectiveness of the cotter. As the washer encircles the entire cross section of the key the shear obtained in the case of the U-type cotter is quadrupled.

When the washer is held in place on the key with the standard brake pin double the shear is obtained on the pin. The head of the key is also made of such shape that the thrust coming on it is at practically all times in the longitudinal center of the key. This device is designed to eliminate the breaking of the draft key retainer and to insure against the loss of the draft key and the pulling out of the coupler due to this cause. It is also designed to minimize the possibilities of reduction of section of either the pin or the cotter by concentrating the chafing or wear of the sill due to the shifting of the key on the washer and head of the key.

Morton 60-in. stroke draw-cut shaper

THE 60-in. stroke, heavy duty, draw-cut shaper now manufactured by the Morton Manufacturing Company, Muskegon Heights, Mich., is of the four screw type. It is manufactured with 36 in., 48 in. and 60 in. of horizontal or side feed on the cross-rail and has 18 in. of vertical feed. It is equipped with a crane and



The Morton 60-in. stroke, heavy duty draw-cut shaper

hoist auxiliary top table, extra heavy steel vise, large tee-slotted work table and a set of O. K. tools and holders, making it complete and ready to run when placed on the foundation. The general construction of this machine is similar to other Morton shapers excepting the size of its ram, column, cross-rail and bed, which are increased to accommodate larger work and heavy duty production.

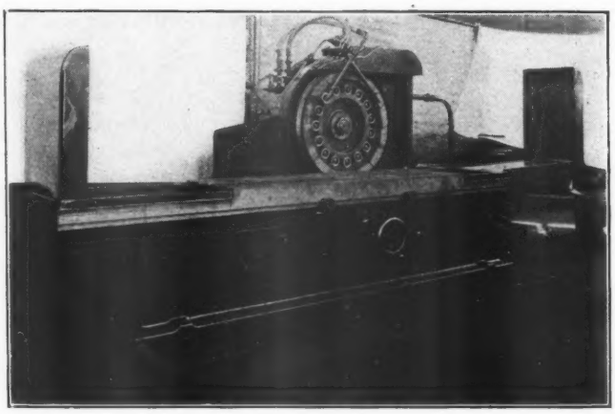
Armstrong spring cutting-off tool

A CUTTING-OFF tool designed to eliminate chatter and prevent tool breakage has been placed on the market by the Armstrong Brothers Tool Company, 351 North Francisco Avenue, Chicago. The "goose neck" form of the tool gives the cutter a resiliency that takes up any chatter and keeps the work from climbing up on the tool. As the cutter is adjustable to any desired clearance, the greatest possible support is obtainable under all conditions. The cutters are beveled on both sides and are held at an angle, giving the side clearance and top rake needed to obtain clean, smooth work.

Cutting-off tool designed to eliminate clatter and prevent tool breakage

Redesigned oil driven face grinding machine

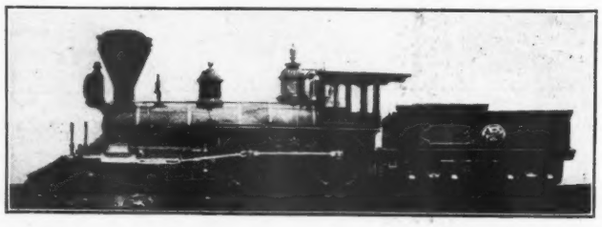
THE Diamond Machine Company, Providence, R. I., has recently placed on the market a redesigned face grinding machine that is an improvement on the former belt-driven machine, as it is oil driven through an oil motor and rack and pinion. The purpose of this type of machine is to increase the ease of operation and to allow an unlimited number of table speeds up to a maximum of 72 ft. per minute. This allows a variation in table travel to suit the particular work, although the general plan of relatively low spindle speeds and fast



Diamond face grinder operated through an oil pump and cylinder

table travel is still recommended as the means of giving the best and most economical results.

The machine is operated through an oil pump and cylinder and, in addition, is designed to grind either on the periphery of a disc wheel or on the face of a cup wheel. By a simple adjustment the abrasive wheel may be set to grind at any angle between the vertical and horizontal. This feature should enable the user to grind vee-ways and other surfaces, which would otherwise have to be machined and scraped, thus effecting a considerable saving in time.



Milwaukee & Northern locomotive No. 4, "Holstein," built by Brooks in 1872—Cylinders 16 in. by 24 in.; diameter of drivers, 60 in.

News of the Month

Plans have been prepared by the Canadian National for the construction of a 30-stall brick and steel roundhouse, with machine shop and accompanying yard facilities at Tecumseh, Ont., at an estimated cost of $1,000,000.

Domestic railway purchases of locomotives, freight cars, and passenger cars

	Locomotives		Freight Cars		Passenger Cars	
	1927	1926	1927	1926	1927	1926
January	26	60	17,196	11,531	314	217
February	85	13	4,185	11,353	246	152
March	70	407	5,253	8,772	212	112
April	27	48	3,362	4,490	6	225
May	184	50	4,378	435	261	30
June	38	191	7,566	4,270	61	124
July	26	14	1,459	1,256	69	68
August	20	84	1,066	164	36	1
Total eight months	476	867	44,465	42,271	1,205	929

Fuel statistics for the month of July

The average cost of coal used as fuel for locomotives in road service by Class I roads in July was $2.64 per ton, as compared with $2.58 in July of last year, according to the Interstate Commerce Commission's monthly summary of railroad fuel statistics. The average cost of fuel oil was 2.77 a gallon, as compared with 2.95 cents. For the seven months ended with July the railroads consumed 55,760,967 net tons of coal, at an average cost of $2.66 a ton, and 1,156,052,883 gallons of fuel oil at 2.9 cents, making a total cost of $181,967,311, as compared with $184,607,528 in the corresponding period of last year.

National uniformity in bolt and nut sizes

Tables of standard sizes for square and hexagonal bolt head and nuts and for the corresponding wrench openings were recently approved by the American Engineering Standards Committee as a tentative American standard. The tables were established by a sectional committee appointed under the procedure of the A. E. S. C. by the organizations sponsoring this work, viz., the Society of Automotive Engineers and the American Society of Mechanical Engineers. The tables deal with rough, semi-finished and finished square and hexagonal bolt heads and regular nuts, finished hexagonal cap screw heads, set screw heads, finished and semi-finished hexagonal jam nuts, hexagonal light nuts, hexagonal and square machine screw nuts, and stove bolt nuts, hexagonal castellated nuts, and wrench openings.

The new standard is meant to introduce national uniformity in a field where wasteful diversity has reigned for a long time. The sizes of bolt heads and nuts are intended to supersede all existing standards which have grown up from commercial standard bolt heads and nuts. The dimensions listed are in accord with the tendencies of recent years toward smaller sizes for bolt heads and nuts than were given by the "U. S. Standard" thus called because it was established by the Navy Department in 1868. However, such reduction has been made only after giving due consideration to the stresses in bolts and nuts and after exhaustive tests of samples had been made.

The standardization of wrench openings corresponding to the different widths across flats of bolt heads and nuts is a very important feature. The opening of a wrench to go with a specific nut should be large enough to permit the wrench to be easily slid on to the nut, and small enough to avoid damage to the corners of the nut when it is tightened. These two requirements result in certain tolerances for both the nuts and the wrench openings. The tolerance on the nut is allowed downward from the nominal size, while the minimum size of the wrench opening is slightly above nominal size; the tolerance on the wrench opening being upward from this reference line. This results in a clearance between even the largest permissible nut and the smallest permissible wrench opening of a specific nominal size.

If bolts and nuts on the one hand, and wrenches on the other hand, are made in accordance with the new standard, all wrenches of a certain size will match in a mechanically perfect manner, all bolt heads and nuts of the same nominal size whatever their make may be. This will not only simplify stock of materials and tools, but it will also give a considerable saving in time and effort in the work of the countless number of persons who have to use bolts and nuts as fastenings.

Copies of the standard may be obtained from the American Engineering Standards Committee, or the sponsor bodies, all located at 29 West 39th Street, New York City, at thirty-five cents a copy.

Meetings and Conventions

Railroad division A. S. M. E. to hold meeting November 15

The first meeting of the 1927-28 season of the Railroad Division, American Society of Mechanical Engineers, is to be held under the auspices of the Metropolitan Section, on November 15, at the Engineering Societies building, 29 West Thirty-ninth street, New York. The subject of the paper, which will be presented by J. M. Taggart, consulting engineer, New York, will be high steam pressure locomotives. Mr. Taggart is well known in the power plant field and the ideas that he has incorporated in his paper have been derived largely from developments in power plant work. A number of engineers prominent in locomotive design have been invited to discuss this paper.

Conference on engineering materials at Berlin, Germany

The tentative program for the Conference on Engineering Materials to be held in Berlin, Germany, October 22 until November 13, has been announced. The program of papers contains about 200 lectures to be presented by prominent scientists and engineers. These papers will be read at the Technical University of Charlottenburg, and are intended primarily for engineers. An exhibition of engineerng materials, arranged in the Neue Ausstellungshalle on the Kaiserdamm, is planned as an additional attraction. There will be seen at the exhibit the most modern methods of material testing and demonstrations of the properties of the different engineering materials and the way of employing and working them. Three groups of materials will be dealt with; namely, iron and steel, non-ferrous metals and electrical insulating materials. More than 200 testing machines will be shown in operation.

Some of the papers of interest to railroad men included in the program are papers on materials for boiler and turbine design, materials for heating and power plants, materials for mechanical

engineering, problems in cutting metals, bearing metals, and welding and soldering.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations and railroad clubs.

AIR-BRAKE ASSOCIATION.—T. L. Burton, 165 Broadway, New York.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—C. Borcherdt, 202 North Hamlin Ave., Chicago.

AMERICAN RAILWAY ASSOCIATION DIVISION V.—MECHANICAL.—V. R. Hawthorne, 431 South Dearborn St., Chicago. Next meeting June 13 to 20, 1928, inclusive, Atlantic City, N. J.

DIVISION V.—EQUIPMENT PAINTING SECTION.—V. R. Hawthorne, Chicago. Convention Hotel Kentucky, Louisville, Ky., Sept. 13, 14 and 15.

DIVISION VI.—PURCHASES AND STORES.—W. J. Farrell, 30 Vesey St., New York.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—G. G. Macina, 11402 Calumet Ave., Chicago.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York. Railroad Division, Marion B. Richardson, associate editor, *Railway Mechanical Engineer*, 30 Church St., New York. Meeting November 15 with Metropolitan Section, Engineering Society's Building, New York. Paper on high pressure steam locomotives by J. M. Taggart, consulting engineer, New York.

AMERICAN SOCIETY FOR STEEL TREATING.—W. H. Eiseman, 4600 Prospect Ave., Cleveland, Ohio.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, 1315 Spruce St., Philadelphia, Pa.

AMERICAN WELDING SOCIETY.—Miss M. M. Kelly, 29 West Thirty-ninth St., New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andrucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago, Ill. Annual meeting, Hotel Sherman, Chicago, October 25-28.

BIRMINGHAM CAR FOREMAN AND CAR INSPECTORS' ASSOCIATION.—P. H. Gillean, 715 South Eightieth Place, Birmingham, Ala. Meeting, second Monday in each month at Birmingham, Y. M. C. A. building.

CANADIAN RAILWAY CLUB.—C. R. Crook, 129 Charon St., Montreal, Que. Regular meetings, second Tuesday in each month, except June, July and August, at Windsor Hotel, Montreal, Que. Next meeting October 11. Paper on car retarders in the humpyard will be read by F. C. Rudd, Union Switch & Signal Company, Swissvale, Pa. Illustrated by moving pictures.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 626 N. Pine Ave., Chicago, Ill. Regular meeting second Monday in each month, except June, July and August, Great Northern Hotel, Chicago. Next meeting October 10. Annual meeting, election of officers, entertainment and dancing.

CAR FOREMEN'S ASSOCIATION OF ST. LOUIS.—F. D. Wiegmar 23rd St., E. St. Louis, Ill. Regular meeting first Tuesday in each month, except June, July and August.

CAR FOREMEN'S CLUB OF LOS ANGELES.—J. W. Krause, 514 East Eighth St., Los Angeles, Cal. Meeting second Friday of each month in the Pacific Electric Club Building, Los Angeles, Cal.

CENTRAL RAILWAY CLUB.—H. D. Vought, 26 Cortlandt St., New York. Regular meetings second Thursday each month, except June, July and August at Hotel Statler, Buffalo.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—(See Railway Car Department Officers' Association.)

CINCINNATI RAILWAY CLUB.—D. R. Boyd, 811 Union Central Building. Regular meeting second Tuesday, February, May, September and November.

CLEVELAD RAILWAY CLUB.—F. L. Frericks, 14416 Adler Ave., Cleveland, Ohio. Meetings first Monday each month, except July, August and September at Hotel Hollenden, East Sixth and Superior Ave., Cleveland.

INTERNATIONAL RAILWAY MASTER BLACKSMITHS' ASSOCIATION.—W. J. Mayer, Michigan Central, 2347 Clark Ave., Detroit, Mich.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—L. G. Plant Railway Exchange, 80 E. Jackson Boulevard, Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabash Ave., Winona, Minn.

LOUISIANA CAR DEPARTMENT ASSOCIATION.—L. Brownlee, New Orleans, La. Meeting third Thursday in each month.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 26 Cortlandt St., New York.

NEW ENGLAND RAILROAD CLUB.—W. E. Cade, Jr., 683 Atlantic Ave., Boston, Mass. Regular meeting second Tuesday in each month, excepting June, July, August and September, Copley-Plaza Hotel, Boston. Next meeting October 11. Geo. Hannover, president, Boston & Maine, will be the speaker at this meeting.

NEW YORK RAILROAD CLUB.—H. D. Vought, 26 Cortlandt St., New York. Meetings third Friday in each month, except June, July and August, at 29 West Thirty-ninth St., New York. Next meeting October 21. Purchases and stores night.

PACIFIC RAILWAY CLUB.—W. S. Wollner, 64 Pine St., San Francisco, Cal. Regular meetings, second Thursday of each month in San Francisco and Oakland, Cal., alternately.

RAILWAY CAR DEPARTMENT OFFICERS' ASSOCIATION.—A. S. Sternberg, Belt railway, Clearing Station, Chicago.

RAILWAY CLUB OF GREENVILLE.—Paul A. Minnis, Bessemer & Lake Erie, Greenville, Pa. Meeting last Friday of each month, except June, July and August.

RAILWAY CLUB OF PITTSBURGH.—J D Conway, 515 Grandview Ave, Pittsburgh, Pa. Regular meeting fourth Thursday in month, except June, July and August. Fort Pitt Hotel, Pittsburgh, Pa.

ST. LOUIS RAILWAY CLUB.—B. W. Frauenthal, Union Station, St. Louis, Mo. Regular meetings, second Friday in each month, except June, July and August.

SOUTHERN AND SOUTHWESTERN RAILWAY CLUB.—A. T. Miller, P. O. Box 1205, Atlanta, Ga. Regular meeting third Thursday in January, March, May, July, September and November.

TEXAS CAR FOREMEN'S ASSOCIATION.—A. I. Parish, 106 West Front St., Fort Worth, Tex. Regular meetings first Tuesday in each month, Terminal Hotel bldg., Fort Worth, Tex.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, 1177 East Ninety-eighth St., Cleveland, Ohio.

WESTERN RAILWAY CLUB.—W. J. Dickinson, 189 West Madison St., Chicago. Regular meetings, third Monday in each month, except June, July and August.

Supply Trade Notes

O. L. Yocum, service engineer of the Hudson Grate Company, Keokuk, Iowa, was accidentally killed on September 3, near Browning, Ill.

The Alexander Milburn Company, Baltimore, Md., has organized an office at 50 Terminal street, Boston, Mass., known as the Alexander Milburn Sales Company, in charge of M. B. Crouse and G. B. Malone.

M. S. Snow, vice-president and director of the Whitman Barnes-Detroit Corporation, Detroit, Mich., has resigned and has been succeeded by Karl Kendig, who is now vice-president and treasurer. H. Z. Callender, sales manager, has been appointed secretary and sales manager and Thomas S. Poole, a representative of the corporation, has been appointed direct factory representative for the southern states territory, succeeding Fred A. Hardin, resigned.

The Vapor Car Heating Company, Inc., Chicago, has taken over from the Phillips Metallic Hose Company, Jackson, Mich., the entire manufacture and sale of the Phillips flexible pipe joint for use in place of rubber steam hose. This flexible metallic joint has been redesigned and is being made in 2-in. size and will be known as the Vapor Company's smooth bore conduit. The Vapor Company will continue to manufacture its other types of joints as required.

Elbert H. Gary

Judge Elbert H. Gary, chairman and chief executive officer of the United States Steel Corporation, died on August 15 at his home in New York, in his eighty-first year. His death was caused by heart disease, his health, however, having been failing for several years. He was born at Wheaton, Ill., and was educated in the public schools, Wheaton College and the University of Chicago, law department, receiving his degree of LL.B. from the latter in 1867. He later received many honorary degrees from other colleges and universities. He was admitted to the bar in 1867, and the bar of the Supreme Court of the United States in 1882. He subsequently served as county judge of Du Page county, Illinois, and practiced law in Chicago for 25 years. Mr. Gary was identified with the organization of the Federal Steel Company and gave up his law practice to become president of the steel company in October, 1888. He took a prominent part in the organization of the United States Steel Corporation of which he was chairman of the board, chairman of the finance committee and chief executive officer in general charge of affairs at the time of his death. He had also served as member of the United States section of the International High Commission and as president of the American Iron & Steel Institute since its founding. He was a member of many clubs and societies and had received a number of decorations from foreign rulers. As head of a large corporation Judge Gary had many problems to solve and the success of the enterprise in no small measure was due to his tact in meeting and adjusting these conditions. He was considered a pioneer in handling corporate publicity and was largely responsible in successfully meeting present-day conditions for his corporation in its contact with its customers and the public.

E. H. Gary

Frank H. Clark, formerly general superintendent of motive power of the Baltimore & Ohio and, more recently, technical adviser to the Chinese Ministry of Communication, has opened an office as consulting engineer at 949 Broadway, New York, where he will undertake examinations and reports on railway and allied industrial problems and undertakings. Mr. Clark entered railway service with the Chicago, Burlington & Quincy, in the employ of which he spent 16 years, serving respectively in the positions of chief draftsman, mechanical engineer, superintendent of motive power and general superintendent of motive power. In 1910 he was appointed general superintendent of motive power of the Baltimore & Ohio and served in that capacity for eight years. Then for a brief period he was engaged in consulting work in New York and in 1919 went to China as technical adviser to the Ministry of Communication. Mr. Clark has served as president of both the American Railway Master Mechanics' Association (part of 1918-19) and the Master Car Builders' Association (1910-11).

F. H. Clark

Lewis K. Sillcox, who resigned as general superintendent of motive power of the Chicago, Milwaukee & St. Paul on September 15, has been appointed assistant to the president of the New York Air Brake Company, with headquarters at New York, effective October 1. Mr. Sillcox was born on April 30, 1886, at Germantown, Pa., and received his schooling at Trinity School, New York, and at the Polytechnic School of the University of Brussels in Belgium. He entered railway service in July, 1903, as a roundhouse apprentice on the New York Central & Hudson River (now the New York Central) at High Bridge, N. Y., leaving railway service three years later to become moulder and assistant superintendent of the McSherry Manufacturing Company, Middletown, Ohio. In 1909 he was appointed shop engineer of the Canadian Car & Foundry Co., Montreal, Que., where he remained until 1912, when he returned to railway service as mechanical engineer of the Canadian Northern (now a part of the Canadian National) at Toronto, Ont. Mr. Sillcox was appointed mechanical engineer of the Illinois Central, with headquarters at Chicago, in 1916, and in 1918 he became master car builder of the Milwaukee, with headquarters at Milwaukee, Wis. On June 1, 1920, he was promoted to assistant general superintendent of motive power, with headquarters at Chicago, and two months later he was again promoted to general superintendent of motive power, a position he held continuously until his resignation and appointment as assistant to the president of the New York Air Brake Company. Mr. Sillcox resigned on September 15 as chairman of the Mechanical Division of the American Railway Association and from all committees of which he was a member. He was elected chairman of the mechanical division in June, 1926, and his present tenure of office would have expired in June, 1928.

L. K. Sillcox

Personal Mention

General

H. W. WILLIAMS, superintendent of motive power of the Western lines of the Chicago, Milwaukee & St. Paul, has been appointed assistant superintendent of motive power of the Western lines, with headquarters as before at Tacoma, Wash.

C. H. MCCONNELL, electrical engineer of the Pittsburgh & Lake Erie at Pittsburgh, Pa., has been appointed mechanical engineer, with headquarters in the same city, succeeding H. Courtney. Mr. McConnell was born at West Bridgewater, Pa., on May 17, 1879. He attended the public schools of Beaver, Pa., and is a graduate of the Beaver, Pa., high school and The Pennsylvania State College. He entered the employ of the Pittsburgh & Lake Erie as an electrician on October 27, 1902. He became chief electrician in January, 1905; assistant electrical engineer in February, 1913, and electrical engineer in October, 1918.

C. H. McConnell

E. B. HALL, superintendent of motive power of the Chicago & North Western at Chicago, has been promoted to general superintendent of motive power and machinery, to succeed H. T. Bentley, who has been retired under the pension rules of the company. Mr. Hall was born on December 1, 1870, at Parkersburg, Iowa, and entered railway service on September 23, 1889, as an engine caretaker on the Chicago & North Western at Eagle Grove, Iowa, and Hawarden. Later he became a machinist helper, which position he held until 1892 when he was made a locomotive fireman. He continued in this employment until 1898, when he was promoted to locomotive engineman. On September 23, 1907, he was appointed road foreman of engines on the Sioux City division at Sioux City, Iowa; on March 1, 1910, he was promoted to master mechanic on the Northern Iowa and Sioux City division with headquarters at Eagle Grove, and from May 1, 1912, to December, 1914, he was master mechanic of the Wisconsin division with headquarters at Chicago. From the latter date until 1914 he was assistant to the general superintendent of motive power at Chicago, handling labor matters. From 1917 to February 1, 1919, he was assistant superintendent of the Wisconsin division at Milwaukee, Wis., and on the latter date was appointed assistant superintendent of motive power and machinery at Chicago, with jurisdiction over lines west of Chicago, including the lines west of the Missouri river. In December, 1919, he became principal assistant superintendent of motive power and machinery at Chicago, with jurisdiction over

E. B. Hall

the entire system and on May 1, 1922, he was promoted to superintendent of motive power and machinery.

David J. Redding, superintendent of motive power of the Pittsburgh & Lake Erie at Pittsburgh, Pa., has retired after 44 years of service. Mr. Redding was born at Vincennes, Ind., on April 21, 1865. He was educated in the Norwalk, Ohio, schools and entered the service of the Lake Shore & Michigan Southern as a machinist apprentice at the Norwalk shops in March, 1881, continuing with that company until April, 1888, when he became a machinist at the McKees Rocks, Pa., shops of the Pittsburgh & Lake Erie. In June, 1888, he was promoted to gang foreman; in June, 1893, promoted to general foreman at Dickerson Run, Pa.; and in November, 1899, transferred as general foreman to McKees Rocks. He became master mechanic at McKees Rocks in December, 1909; assistant superintendent motive power in December, 1909, and superintendent motive power in June, 1923. Mr. Redding's retirement is due to ill health.

D. J. Redding

Ralph W. Anderson, superintendent of motive power of the Eastern lines of the Chicago, Milwaukee & St. Paul at Milwaukee, Wis., has been promoted to superintendent of motive power of the entire system, with headquarters at the same point.

Master Mechanics and Road Foremen

J. N. Chapman, who has been appointed master mechanic of the Illinois Central with headquarters at McComb, Miss., was born on June 11, 1886, at Water Valley, Miss. He received a high school education and in 1902 became a machinist apprentice on the Illinois Central. He finished his apprenticeship in 1907 and in 1908 was promoted to roundhouse foreman. In 1911 he accepted a position on the Missouri Pacific and in 1913 returned to the Illinois Central. In 1915 he became mechanical inspector of the system; in 1917, general foreman at McComb, and a few months later district foreman at New Orleans. He assumed the duties of master mechanic at McComb on July 25 of this year.

J. N. Chapman

W. W. Wickline, traveling fireman of the Chesapeake & Ohio, has been appointed road foreman of engines, Sewell Valley sub-division, with headquarters at Rainelle, W. Va.

W. W. Payne has been appointed road foreman of engines of the Alabama division of the Seaboard Air Line, with headquarters at Savannah, Ga., succeeding A. E. Hopkins, deceased.

A. H. Whittaker, general foreman in the locomotive department of the Seaboard Air Line at Portsmouth, Va. has been appointed master mechanic of the West Florida division of the road, with headquarters at St. Petersburg, Fla., succeeding H. C. Quarles.

H. C. Quarles, master mechanic of the West Florida division of the Seaboard Air Line at St. Petersburg, Fla., has been transferred in the same capacity to the South Florida division, with headquarters at Arcadia, Fla., succeeding F. S. Markett who has resigned.

Shop and Enginehouse

E. C. Roddie, who has been appointed shop superintendent of the Illinois Central, with headquarters at Paducah, Ky., entered the service of the Illinois Central as a machinist at Jackson, Tenn., later serving as a machinist also at Paducah, Vicksburg, Miss., and New Orleans, La. He became foreman, in charge of passenger roundhouse, at New Orleans on August 1, 1901; general foreman locomotive and car departments at New Orleans, April 1, 1905; district foreman, New Orleans terminal, May, 1912, and master mechanic at McComb, Miss., October 16, 1926. He held the latter position at the time of his transfer to Paducah as shop superintendent.

J. L. Chapman, general foreman of the Illinois Central at Water Valley, Miss., has been appointed general machine and erecting foreman, with headquarters at Paducah, Ky.

Car Department

F. M. Lewis, car foreman of the Union Pacific at Green River, Wyo., has been appointed general car foreman, with headquarters at Kansas City, Kans.

William Lee, assistant car foreman of the Union Pacific at Kansas City, Kans., has been promoted to car foreman, with headquarters at the same point, succeeding C. E. Wood.

H. E. Lyell, passenger car foreman of the Tennessee Central, has been appointed general foreman car department, with headquarters at Nashville, Tenn., succeeding T. A. Saunders, who has been appointed master car builder.

The title of K. F. Nystrom, master car builder of the Chicago, Milwaukee & St. Paul at Milwaukee, Wis., has been changed to superintendent of the car department of the entire system, and the title of master car builder has been discontinued.

The titles of J. A. Deppe and F. D. Campbell, assistant master car builders of the Chicago, Milwaukee & St. Paul at Milwaukee, Wis., and Tacoma, Wash., respectively, have been changed to assistant superintendents of the car department and the titles of assistant master car builders have been discontinued.

Purchases and Stores

E. A. Porter has been appointed division storekeeper of the Missouri Pacific, with headquarters at Monroe, La.

B. W. Griffith has been appointed general storekeeper of the New York Central, with headquarters at West Albany, N. Y.

W. R. Caldwell, division storekeeper of the Missouri Pacific at Monroe, has been transferred to Kansas City, Kans., to succeed M. E. Bailie.

H. A. Paar, division storekeeper of the Michigan Central at Detroit, Mich., has been appointed assistant general storekeeper, with the same headquarters, to succeed A. M. Gage.

A. M. Gage, assistant general storekeeper of the Michigan Central at Detroit, Mich., has been appointed general storekeeper, with the same headquarters, to succeed B. W. Griffith.

Obituary

Joseph C. Schepp, master mechanic on the Texas & Pacific, with headquarters at Texarkana, Tex., from 1914 to 1917, died at Ft. Wayne, Ind., on September 26. Prior to 1914 he had been general foreman of shops of the T. & P. at Marshall, Tex.

Frank J. Kraemer, division master mechanic on the Missouri Pacific until his retirement from active service in 1924, died at Little Rock, Ark., on September 13. Mr. Kraemer served from 1906 to 1924 as master mechanic at Baring Cross, Ark., at Little Rock and at Argenta and at Atchison, Kan.